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Notes on North American Sphagnum. XI. Sphagnum subsecundum — *A. LeRoy Andrews* 87
Amblystegium — *Henry S. Conard* 96
Two new mosses from the Philippines — *Nieva E. Veloira* 104
Notes on Hawaiian Hepaticae. III. Relationships among Herpocladium, Herberta, and Acromastigum — *Harvey A. Miller and E. B. Scott* 109
Notes on Hawaiian Hepaticae. IV. Herberta herpocladioides sp. nov. — *E. B. Scott and Harvey A. Miller* 116
A natural hybrid in the Ditrichaceae — *A. LeRoy Andrews and Frederick J. Hermann* 119
New or interesting Parmelias from North and tropical America — *Mason E. Hale, Jr.* 123
The habitat of Aschisma kansanum — *Arthur A. Cridland* 132
Frullania laxiflora — *Lois Clark* 135
Range extensions of bryophytes in eastern United States — *F. J. Hermann* 138
Additions to the Hepaticae of Ontario — *H. Williams and R. F. Cain* 145
Some Mexican lichens — *W. L. Dix* 148
Peristome teeth in polarized light — *Edward C. Taylor, Sr.* 149
Discelium nudum in eastern New York — *Herbert M. Mapes* 155
Pterigoneurum ovatum in Ontario — *Harry Williams* 156
Recent literature 158
News and Notes 162

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NOTES ON NORTH AMERICAN SPHAGNUM. XI. SPHAGNUM SUBSECUNDUM

A. LEROY ANDREWS*

Though all *Sphagna*, like most of the bryophytes, show some variation, *Sphagnum subsecundum* Nees, taken in a broad sense, has by universal agreement long been considered the most variable species of the genus. This has led to corresponding variation in its treatment by bryologists down to the present time. From the tendency, represented especially by Warnstorf and now general, to recognize a section or subsection or group *Subsecunda* I have differed by including it in the section or series CUSPIDATA,[1] with which it agrees in essential characters. On the specific level there is not now and never has been agreement as to whether *S. subsecundum* is a single species, several species or a multitude of species. Some bryologists have not even agreed with themselves at different periods of their study. As my point of view has been the most synthetic one, I have long felt that I should give more definite reasons for the reduction to *S. subsecundum* of many species,[2] and this seems still more necessary now that the monograph of Warnstorf[3] has again been made available. Warnstorf's concept of the number of species of this type was a constantly expanding one, which reached its culmination in his monograph, becoming a veritable monstrosity:

Monstrum horrendum, informe, ingens, cui lumen ademptum.

Under his subsection SUBSECUNDA are listed and described from the world as a whole 114 species. Of these our *S. Pylaesii* Brid.

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[1] Bryol. 14: 72ff. 1911; Ann. Bryol. 9: 6ff. 1937.

[2] No. Amer. Fl. 15: 21. 1913.

[3] Sphagnales-Sphagnaceae *in* Engler, Pflanzenreich, Heft 51, 1911. Photomechanischer Neudruck, Engelmann (J. Cramer). 1958.

is, of course, distinct; so are obviously *S. Novo-caledoniae* Par. & Warnst., *S. gracilescens* Hpe. from South America, and probably a few others. The rest belong in the mass of variable *S. subsecundum* Nees, about which differences of opinion are current.

Leaving aside for the moment the exotic regions whose *Sphagnum*-flora may be considered as less definitely known and confining ourselves to Europe and North America, and omitting *S. Pylaesii*, which is anyhow not too closely related to *S. subsecundum*, Warnstorf's monograph lists for Europe 17 species, for North America 36, common to both 12. I think I may safely say that no present European bryologist recognizes the 17 European species, and certainly no American bryologist recognizes the 36. The main emphasis would naturally be on the 12 species common to both continents, whose names in part antedate Warnstorf, but I am not aware that anyone now recognizes all of them. Warnstorf further provides them with an almost endless series of named varieties and forms. My reduction of all (except *S. Pylaesii* and the American *S. cyclophyllum*) to the single species *S. subsecundum* stands not entirely alone. G. Åberg, who in his unfortunately short career gave the European SUBSECUNDA the most independent and thorough of recent treatments,[4] admitted only two species and even expressed doubts about the American *S. cyclophyllum*.

In my first *Sphagnum* publication, an attempt to checklist the New England species,[5] I tried to follow Warnstorf, who had not yet reached the full degree of inflation of his future monograph, but later, after investigating a very large number of specimens from many localities, I found that there were no clearly recognizable lines of demarcation between the various species and was forced to the conclusion that the material represented rather a single very variable species. The alternative of dividing into a number of subspecies, or better yet varieties, would be appealing and was followed in limited degree by Åberg, but even that I have not yet found very satisfactory, as it seems to involve an artificial attempt to mark certain lines of variation rather than to recognize a natural grouping which could be consistently followed by other bryologists. The possibility which had occurred to me that the great variability might rest upon chromosome differences is rendered questionable by the researches of Mrs. Virginia Bryan, who found that two seemingly different forms of *S. subsecundum* showed no appreciable chromosome distinctions.[6]

[4] Ark. f. Bot. 29A(1), 1937.
[5] Rhodora 8: 62ff. 1906.
[6] Bryol. 58: 27. 1955.

In the following it is my purpose to discuss the various characters that have been employed to separate species within this complex of forms. At the outset it must be said that my observations are not original as they were all or practically all anticipated long ago by Russow. It cannot be sufficiently emphasized that present knowledge of *Sphagnum* owes much more to Russow than to any other one person. Morphological and anatomical knowledge of the genus has hardly advanced an iota beyond his publications of the last century, and the only new contribution of importance is in the cytological study of the chromosomes, which is as yet in its initial stages and whose taxonomic bearing is still problematical. Russow's publications are unfortunately not easily accessible as they appeared in Dorpat (Jurjew, Tartu), Estonia. Most important for our purpose is the final one entitled "Zur Kenntnis der Subsecundum- und Cymbifoliumgruppen europäischer Torfmoose."[7] In this he broke definitely with Warnstorf, who was already developing the irresponsible treatment of the SUBSECUNDA which culminated in his later monograph.

In the first place the gross external appearance varies widely. The plants may be small and delicate or large enough to be confused with INOPHLOEA species. They may be growing in merely wet localities or in mucky swamps or even in aquatic conditions; they are not a characteristic bog plant, but are otherwise ecologically tolerant. They may be green or purplish-tinged. Their branches or branch leaves are by no means always subsecund as the name implies, though they often are. Differences in habitat naturally affect the macroscopic as well as to some extent the microscopic features.

Turning to the microscopic characters which should be diagnostic and are generally so used, they are of three sorts; *first*, the pores of the branch leaves, *second*, the relative size of the stem leaves, and, *third*, the cortical cells of the stem section. The position and form in section of the chlorophyll cells of the branch leaves is in ACISPHAGNUM a group–rather than species–character and runs rather uniform through the *subsecundum* forms.

What has long been considered characteristic of *S. subsecundum* and is in fact a convenient first test for it is the number and arrangement of the pores, especially on the dorsal surface of the branch leaves, these being typically very numerous and arranged along the cell commissures in close order suggesting strings of beads. They tend to be small, but may vary a little in size, round if viewed directly but appearing slightly oval or elliptical if seen

[7] Ark. Naturkunde Liv-, Ehst.- und Kurlands. *2*, 10(4), 1894.

partly in profile because of slight convexity of the cell membrane, and more or less "ringed." The ventral surface of the leaf may show similar pores, but mostly in lesser number. It is true that the number of pores may be reduced greatly, even down pretty well to the zero point. Russow already realized that aquatic conditions reduce the number of pores, that such reduction is then not entirely a genotypic feature. *S. obesum* Wils. is, for example, such an aquatic form. H. Paul[8] confirmed this point by subjecting plants to more aquatic conditions.

The stem leaves, which in some groups of *Sphagnum* furnish such sensitive specific indicators, are of doubtful help in dismembering *S. subsecundum*. Measurements are of little value as the leaves are naturally larger in the larger plants than in the smaller ones. Furthermore the size as well as the shape and presence or absence of fibrils and pores is complicated by the so-called hemi-isophylly, that is, in not fully normal specimens, especially in those growing in aquatic conditions, the tendency of stem leaves to revert to the branch-leaf type, in which case they may be larger than otherwise. Their shape is normally lingulate or slightly triangular-lingulate but varies toward the ovate, especially in the hemi-isophyllous forms.

The final resort in subdividing the species is the condition of the stem cortex. It is immediately striking that the stem section generally shows a single layer of enlarged cortical cells sharply set off from the adjacent inner cellular structure. But it was soon discovered that there are forms not otherwise very different that have their cortical cells in two layers. The separation based upon this fact is the most persistent one and the one employed by Åberg to distinguish the two species to which he reduces the whole *subsecundum* complex. It might easily seem to be the most fundamental of the distinguishing features, or it is at any rate the most easily recognized. But Russow already noted that some stems may have cortical cells in one and one-half layers. He even speaks of single stems which showed at one point cortical cells in one layer, at another one and one-half and at still another point two layers. Such cases occur where a stem section shows two layers of differentiated cortical cells in part of the perimeter or scattered cells in the second layer or the second layer of smaller cells forming something of a transition to the sclerodermis within. Rarely, even cortical cells of a third layer may be found. This phenomenon is of decided interest as showing how the normal *Sphagnum* stem cortex is here in process of evolving a sharply set off single layer of large cells.

[8] Der Einfluss des Wassers auf die Gestaltungsverhältnisse der *Sphagna*. Abh. Nat. Ver. Bremens 28, 1932.

But in view of the variation, unless other supporting characters can be found, specific separation is still dubious. Although Warnstorf uses this character as others do, it is noteworthy that in several of his descriptions of exotic species of the SUBSECUNDA he includes "hyalodermis stratis 1-2"; that is, he recognizes that the cortical cells vary between one and two layers in the same species.

Although Russow recognized the variability of all these features in the *Sphagnum subsecundum* complex, he did employ them to separate a limited number of species. He used the separation by cortical cell layers of *S. subsecundum* (one layer) and *S. contortum* (two layers), but found it, besides being variable, not well supported by other characters and termed it a practical but artificial rather than natural separation. On the basis of larger stem leaves he separated *S. isophyllum* (now generally called *platyphyllum* from *S. contortum*, as well as *S. inundatum* and *S. Gravetii* (the latter now generally called *auriculatum*) from *S. subsecundum*. But he regarded *S. isophyllum* and *S. Gravetii* as a natural group, while another natural group was constituted by the other three species. If one were to judge natural grouping by external appearance solely, this conclusion might in some measure seem justified, but in backing it by microscopic features he appears to me to have made his most serious mistake in that he over-emphasized pore characters, which is just what he had criticized Warnstorf for doing. In defense he stated that his emphasis was upon pore distribution rather than number and that it involved a consideration of stem leaves as well as branch leaves. The difference as he puts it is, as follows: A. ENANTIOPORA (*S. contortum, subsecundum, inundatum*) with pores of branch leaves mainly on the dorsal surface, those of stem leaves mainly on the ventral surface. B. HOMOPORA (*S. isophyllum, Gravetii*) with pores of both stem and branch leaves mainly on dorsal surface. But Russow was perfectly well aware that the normal, differentiated stem leaf of the *subsecundum* complex has extensive cellular membrane resorption on the ventral, not on the dorsal surface. It is only the hemi-isophylly that in various degrees shows stem leaves resembling the branch leaves with fibrillose hyaline cells and normal pores (not irregular membrane resorption) mainly on the dorsal surface. Aberg properly subordinates this point, finding names for a whole series of degrees of isophylly, from anisophyllous through subanisophyllous, hemi-isophyllous to subisophyllous, connecting all the way by transitions. As Aberg's treatment is the only relatively recent one attempting to use independently and exhaustively the available details, it merits further consideration. He

evaluates the three characters in the following order: 1. stem cortex, 2. stem leaves, 3. pores of branch leaves. He admits only no. 1 (the stem cortex) as separating species, namely *S. contortum* and *S. subsecundum*, and that not without transitions as indicated in his key: "A. Stammhyaldm. (1-)2-3-(4) schichtig" for *S. contortum* and "B. Stammhyaldm. 1-(2) schichtig" for *S. subsecundum*. Characters nos. 2 and 3 he employs only for varieties, which correspond to Russow's species except that no. 3 (the pores of branch leaves) provides the means of separating two further varieties not recognized as species or varieties by Russow. His *S. contortum* var. *platyphyllum* corresponds then to Russow's *S. isophyllum*, his S. *subsecundum* var. *inundatum* to Russow's *S. inundatum*, but from it is also separated var. *bavaricum* with more porose branch leaves. His *S. subsecundum* var. *auriculatum* corresponds to Russow's *S. Gravetii*, but from it he also separated var. *rufescens* with more porose branch leaves. An especial merit of Aberg's work is found in the very clear reproductions of small portions of the surfaces of branch leaves showing the relations of pores, pseudopores, and pseudopores containing real pores (*Hofporen*, which I had rendered, perhaps unsatisfactorily, by vestibuled pores). He furnishes enough of these illustrations to show that even within the same variety there is variation.

Unless one can find some other new approach to the problem, the careful and detailed studies of Russow and later of Aberg certainly form the only substantial basis upon which one can work in attempting to subdivide *S. subsecundum* into subspecies or varieties. Any attempt to follow Warnstorf will merely bog one down in a hopeless morass. On this basis one can with a certain degree of consistency segregate a limited number of varieties, but they overlap, as admitted by Aberg, they show not much if any correlation of characters, and, like many named varieties in the bryophytes, they appear to be rather forms which are mechanically categorized than natural groups which can be recognized as such.

For exotic regions Warnstorf is still more unrestrained and lists an incredible number of species, mostly endemic to the particular region in each case. These of course require further study. My impression, for what it is worth from incomplete study, is that at the very most ten or a dozen of these may differ sufficiently from the forms of our northern *S. subsecundum* to justify recognition as independent taxa. For South America, for example, Warnstorf has 28 species of this group, all but one endemic. To a great extent they duplicate northern forms. However, *S. gracilescens* Hpe. needs mention as a clearly marked species. It is con-

fined to eastern South America, Brazil according to Warnstorf, but I have besides specimens from Brazil also two from Venezuela: Miranda state, *Steyermark*, 1945[9] and Bolivar state, *Vareschi & Foldats*, 1956. It has the chlorophyll cells of its branch leaves exposed or more exposed on the ventral surface and might on this character be included in the ACUTIFOLIA group as Russow, who had seen it, also remarked. The numerous pores on the dorsal surface of its branch leaves are similar to those of *S. subsecundum* and had thus suggested its inclusion in the SUBSECUNDA. Its pigmentation is brownish, not reddish as in the other South American ACUTIFOLIA, and it has otherwise the general appearance of the SUBSECUNDA.

The African *Sphagna* are still imperfectly known. From the continent and the islands off its eastern coast Warnstorf listed 19 species of the SUBSECUNDA plus four of the MUCRONATA, all endemic. Sim[10] with inadequate material made a praiseworthy attempt to treat the South African species and reduced to synonymy a number of those of Carl Müller and Warnstorf. Garside[11] with more material criticized Sim's work in some respects, but continued the reduction of species. For the prevalent *Subsecundum* form he employed the name *S. truncatum* Hornsch. as the oldest for Africa, with numerous synonyms. From what he says of it, including its great variability, and from the limited material that I have seen, I doubt that it is really separable from the *S. subsecundum* of the rest of the world. *S. capense* Hornsch., *S. pycnocladulum* C.M., and *S. panduraefolium* C.M. need further study as Garside recognized. *S. pycnocladulum* is placed by Warnstorf in a separate group, the MUCRONATA, which I have included together with the SUBSECUNDA in the series CUSPIDATA. Specifically, it is at any rate quite distinct from *S. subsecundum*.

For New Zealand Sainsbury[12] has treated *S. novo-zelandicum* Mitt. as *S. subsecundum*, I think correctly. For Australia Warnstorf listed, besides the New Zealand species, 10 other endemic ones. Of these ten I have authentic material of five, named by Warnstorf, plus considerable other material sent by Willis. This material shows the usual types of variation of *S. subsecundum*, including that of the stem cortex, and there is also a subsimplex, or simplex, form collected by Willis. I have much doubt that species separable from *S. subsecundum* are involved.

[9] Reported already by Bartram, Fieldiana: Bot. 28: 696. 1957.
[10] Trans. Roy. Soc. So. Africa 15: 129ff. 1926.
[11] Jour. So. African Bot. 15: 59ff. 1949.
[12] Handbook of New Zealand Mosses, p. 16. 1955.

From Asia, with islands off its east coast, Warnstorf's monograph lists some 11 (12 with *S. Novo-caledoniae*) endemic species of SUBSECUNDA, mostly from Japan. The Russian (both European and Asiatic) *Sphagna* have recently been given a very extensive treatment by the veteran bryologist Lydia Savich (now Savich-Lyubitzkaya).[13] For the SUBSECUNDA she recognizes exactly the species of Russow, substituting *platyphyllum* for *isophyllum*, but retaining *Gravetii*, but includes, besides these, from Asiatic Russia two species of her own, *S. orientale* and *S. perfoliatum*, which had already been duly described in an earlier publication.[14] Her good illustrations of the branch-leaf pores of both these new species show a third median row of pores besides those along the commissures of the cells, a feature not otherwise recorded for European or North American forms, but seemingly matched in a limited way by forms in other parts of the world, as will be mentioned later.

The Japanese *Sphagna* are now being studied by Hyoji Suzuki. Judging from his several publications he evidently finds the Japanese species duplicating the European and North American circumboreal ones, which agrees with my own conclusions. Only for the SUBSECUNDA, to which he devotes a special publication,[15] is he influenced by Warnstorf's monograph to recognize eight species, including a new one of his own. Among them are the familiar *S. subsecundum*, *S. contortum*, and from a single locality *S. platyphyllum*. The remaining five species are supposed to be endemic or confined to Japan and Korea. This large number of species seems to be contradicted by his introductory remarks in which he emphasizes the familiar variability according to external conditions of all the characters. Russow is apparently not used, not even included in the bibliography, though considerable reference is made to Aberg. This paper of Suzuki had already been preceded by another containing a very extensive treatment of one of the Warnstorf species, *S. quixassanense*,[16] a subsimplex form which Suzuki would further divide into three subspecies. With all recognition of the remarkable industry of the author and the quality of his drawings, one is impressed by the fact that they bring out noth-

[13] Fl. Plant. Crypt. URSS I. Musci Frondosi 1: 122ff. 1952.

[14] Notulae systematicae e Sectione Cryptogamica Instituti Botanici nomine V. L. Komarovii Academiae Scientiarum URSS 7: 206-211. 1951. I cite the Latinized title of the series. The many series of publications of the various Russian Academies of Sciences are difficult to catalogue, to find and to cite. It took me a long time to discover that the original descriptions of the two Savich *Sphagnum* species were actually in the Mann Library of Cornell University.

[15] Jap. Jour. Bot. 16: 227-268. 1958.

[16] Jour. Sci. Hiroshima Univ., Ser. B, Div. 2 (Bot.), 6: 281-295. 1954.

ing new, except perhaps in the case of the subspecies *triseriporum* of *S. guwassanense*, which shows a triple series of pores on the outer surface of the leaf cells. This reminds one of Savich's Siberian species, as Suzuki notes in his later publication. But her two species, which seem to differ from each other only by slight quantitative differences, are not subsimplex forms, both being described as having branches in fascicles of five. Forms with few or no branches are not peculiar to Japan and remain to be discussed under *S. cyclophyllum*. Åberg characterizes them under such terms as subsimplex (to which simplex might be added), monoclad, and oligoclad and finds them especially common in the variety *platyphyllum*, but also present in other varieties, thus having themselves no specific or even varietal value. As Suzuki finds the third median line of pores in the leaf cells of his subspecies *triseriporum* at most of subspecific value, the specific status of the two Siberian species showing it might perhaps call for critical consideration. Warnstorf describes a species, *S. turgescens*, from Brazil with similar pores. Garside shows a similar condition in *S. pandurae folium* C.M. from South Africa, which he also represents as a subsimplex form. Warnstorf also shows similar pores in *S. Novo-caledoniae* Par. & Warnst., but this species with its lack of cross-fibrils in branch-leaf cells and chlorophyllose cells exposed mainly on the ventral surface of branch leaves apparently has little to do with *S. subsecundum*.

I have, first and last, received many specimens of *Sphagnum* from Japan, in earlier days from Ishiba, latterly from Noguchi, including specimens from some of the collectors cited by Suzuki, and have two of the subspecies of *S. guwassenense*, unfortunately not the *triseriporum*. In the specimens I have examined and in the descriptions and drawings of Suzuki, I am unable to see anything specifically different from the variations of *S. subsecundum* found in Europe and North America. Only with reference to the Siberian and Japanese forms with the triple series of pores in the branch-leaf cells I can express no opinion.

There exists also a "Preliminary study of the Chinese *Sphagnum*" by P. Chen and S. Lee.[17] This is printed in Chinese with an English summary and with illustrative plates well drawn, but on poor paper. As the title suggests it does not claim to be a critical treatment but is an attempt to adjust Chinese collections to the species of Warnstorf's monograph. Besides *S. subsecundum* and *S. auriculatum* it lists four species of the SUBSECUNDA, only one of them coinciding with those of Suzuki, who however makes it

[17] Acta Phytotax. 5: 165-203, with 25 plates. 1956.

a synonym of another Warnstorfian species. From the drawings furnished as well as from Warnstorf's descriptions and drawings, I again have great doubt that anything specifically separable from the European and North American variations of *S. subsecundum* is involved.

If one adopts the wholesale reduction of the SUBSECUNDA species, there still remains the question of the legitimate name. It is remarkable that, in view of the abundance and variability of the species, no name has been found applying to it before 1819, in which year both *S. subsecundum* Nees[18] and *S. contortum* Schultz[19] were published. In such cases priority is difficult to prove, and I have found no reason to substitute *S. contortum* for the better known *S. subsecundum*. My arrangement was also passed over without comment by Dr. J. H. Barnhart, whose editorial notes I still possess. With his profound knowledge of botanical bibliography and the New York Botanical Garden interest in priority at that time, he could have been depended on to rectify any error, if demonstrable as such. Of course, if the two species are recognized as distinct, the question of priority is immaterial. It should be added that the stem cortex distinction was not noted in the original description of *S. contortum* and was first detected as a character of *S. laricinum* Spruce,[20] but later investigation of the type of *S. contortum* by Limpricht showed that it possessed this character, and it accordingly supplanted the later *S. laricinum*.

[18] Ex Sturm, Deutsch. Fl. Crypt. 17: pl. 3. 1819.

[19] Prodr. Fl. Starg., Suppl. 64, 1819.

[20] Ex Schliephacke, Verh. K.K. Zool.-Bot. Ges. Wien 15: 408. 1865. The double- to triple-layered cortex had been described still earlier by Wilson for the Spruce plant which he called *S. contortum* var. *S. laricinum* (Bryol. Brit. 23. 1855). Wilson in this treatment made *S. subsecundum* a var. α of *S. contortum*, but suggested in a note that var. *laricinum* might well prove to be an independent species between *S. subsecundum* and *S. contortum*.

AMBLYSTEGIUM

HENRY S. CONARD[1]

The genus *Amblystegium* had an unfortunate beginning. The name was invented by the author or authors of a monograph in *Bryologia Europaea*, 1853. It was said to be derived from αμβλυς, short, and στεγη, lid or cover. The latter Greek word was a misprint for στεγις. It was correctly printed (in arabic letters) in

[1] Lake Hamilton, Florida.

Limpricht's *Laubmoose*. Dixon (1924) cited a roof, lid, as a root of *Amblystegium*.

The list of species to be included has suffered many changes. For North America the treatment in Grout's *Mosses with Handlens and Microscope* is the most satisfactory. These notes are based on that treatment. The elevation of *Leptodictyum* to generic status by Warnstorf (1906) and of *Hygroamblystegium* to generic status by Loeske (1903) was in harmony with the standards of that period. The arguments for and against these changes are too well known to need repetition. In brief, (1) there are no sharp boundaries between the putative genera, and (2) the total number of species is small and not unwieldy. One area of overlap I have not seen mentioned in this connection, though it is on record in Limpricht and elsewhere, is that the midrib of the perichaetial leaves of *A. varium* is broad, yellow, and excurrent as in *Hygroamblystegium*, entirely different from the thin, pale, rarely percurrent midribs of other *Amblystegia*.

Both Moenkemeyer (1927) and Jennings (1951) retained in *Amblystegium* the species sometimes attributed to *Leptodictyum*. Both retained *Hygroamblystegium* (spelled *Hygramblystegium* by Moenkemeyer). The time has come to return to the *Amblystegium* of Grout's *Mosses with Handlens and Microscope*, reducing *Leptodictyum* and *Hygroamblystegium* to subgeneric status, or no status at all.

Cheney (1897) wrote that "the genus will always prove a troublesome one to the systematist." Part of the difficulty in identification is due to the material studied. It is essential to study the leaves of shoots of indeterminate or unlimited growth. Presumably that is the meaning of the term "stem leaves." Many branches have only a limited or determinate growth. Their leaves are less and less characteristic of the species as the branchlets are farther and farther from the unlimited shoot. Some branches, however, are indeterminate (and are therefore "stems") and are entirely characteristic. Curiously enough, the shoots which bear sporophytes are not good representatives of the species. They have smaller and less characteristic leaves than those of strong vegetative shoots. When two or more species are growing together, only experience and "trial and error" can determine which is which.

Sporophytes have never yielded good diagnostic characters of species. The sizes of all parts vary greatly according to vigor. The plication of perichaetial leaves in *A. riparium* is usually not demonstrable, and is not mentioned by Cheney. The abruptly

acuminate outline and serrulate margins of perichaetial leaves attributed to some species are not at all constant. The one distinctive feature is the wide, yellow costa, usually excurrent, of the larger perichaetial leaves in *A. varium* and other *Hygroamblystegia*. In all others I find the costa thin and pale, and not so much as percurrent. In addition, many forms, especially floating or submerged forms, never produce sporophytes. The species, varieties and forms are based on leaf characters (Cheney, 1897).

It is desirable to have either fresh specimens or those which have been dried without pressure. The posture of the leaves, both wet and air-dried, is highly diagnostic: *e.g.*, erect-spreading in *A. serpens;* nearly at right angles to the stem and nearly flat in *A. juratzkanum* and *A. trichopodium;* nearly at right angles to widely erect-spreading and peculiarly curved and twisted longitudinally, and some leaves obliquely attached in *A. riparium*.

The most exquisite illustrations of *Amblystegia* are in the *Bryologia Europaea*, vol. 6. The pertinent ones are copied in Grout's *Mosses with Handlens and Microscope*. The most detailed descriptions I know of are in Cheney (1897) and in Limpricht's *Laubmoose*. Scarcely less complete are the descriptions and illustrations in Jennings (1951) and Welch (1957). It will be necessary here to mention only such details as are pertinent to this inquiry.

Of Grout's list of species *A.* (or *H.*) *orthocladon* must be reduced to synonymy under *A. fluviatile*. Grout expressed doubts about its validity, and Cheney stated that Palisot de Beauvois' type is a form of *A. fluviatile*. Thus one source of confusion is removed.

A. trichopodium has been satisfactorily defined, together with var. *kochii*, in Grout's *Moss Flora of North America*. In *Amblystegium* it will be *A. trichopodium* (Schultz) C. Hartm., with var. *kochii* (B. & S.) Lindb.

Amblystegium riparium "is probably the most variable of all our Amblystegia" (Cheney, 1897, p. 282). The unifying characters of all of its putative members are (1) the "very entire or rarely subserrate" margins of the leaves, (2) the spindle-shaped median cells in a single layer, (3) the numerous, relatively large, quadrate basal cells, (4) the generally lanceolate (narrowly or broadly) outline of the leaves, and (5) the presence of a midrib ending well below the apex.

According to Cheney, the type of *A. riparium* is "probably not in existence." Among exsiccati Cheney cited Sull. & Lesq. Musci Bor.-Amer. (Ed. 1) 349 and (Ed. 2) 527. To these may be added

Grout's N. Amer. Musci Pleur. 163, 206, and 488. The illustrations in plate 570 of the *Bryologia Europaea* and plate 13 of Cheney's paper show the typical plant.

Limpricht listed six varieties of *A. riparium*. Moenkemeyer listed nine forms, of which one is *trichopodium*, considered a valid species by Grout. Grout changed his earlier varieties to forms in his *Moss Flora*, where he recognized three forms, three varieties and three subspecies. Some time later he remarked that another time he would ignore all forms, because their number seems to be endless. However, all of these conditions occur in nature, and all must be recorded and described somehow, somewhere.

I find that the names *longifolium*, *elongatum*, *flaccidum*, *fluitans* and *obtusum* (Grout's *Moss Flora*) are useful. I prefer to regard *A. sipho* and *A. vacillans* as valid species. Four other names remain to be considered: *abbreviatum*, *brachyphyllum*, *brevipes* and *laxirete*.

If my specimen of *abbreviatum* is properly named (by Grout), it is only a short, tufted, xeric specimen, not even deserving a Latin name as a form. The plant appears in the *Bryologia Europaea* (plate 571) as var. β. It is not mentioned by Limpricht or Moenkemeyer. Cheney includes it and notes that the leaves are "as in the species except a little smaller in size. . . . Probably this . . . will have to be omitted when more material can be obtained for study." Of course, such plants exist and should be mentioned.

A. brachyphyllum Card. & Thér. *in* Holz., Minn. Bot. Studies 3: 123. 1903,[2] was recorded by Grout as a variety of *Leptodictyum riparium*. *A. brevipes* Card. & Thér., *l. c.*, p. 124, was recorded as a subspecies. The type of the former was from Granite Falls, Minnesota, of the latter from near Montevideo, Minnesota. I have collected such material in many places: from Ortonville and Montevideo, Minnesota; Blair, Nebraska; many localities in Iowa; and in Illinois. I have others from Missouri, Indiana, Ohio, and Pennsylvania. With so much material at hand I find that the alleged differences between Cardot & Thériot's two species are of no significance, in spite of Holzinger's note that *brevipes* "is well distinguished" from *brachyphyllum* "by the larger size, the blunt acumen, the longer and narrower cells, and the stronger costa." The differences in apex are not supported by plate 20, fig. 2c and 3b (Cardot & Thériot, *l.c.*). All possible gradations between the two types occur. They are included in Grout's expression: "the

[2] "*A. riparío* affine, a quo differt foliis brevioribus, ovato-lanceolatis, 1.6-1.7 millim. longis, .7 latis, breviter acuminatis, apice obtuso vel subobtuso. Costa valida, basi dilatata, 50-80 mu lata, usque ad 2/3 vel 3/4 folii producta. Cellulae mediae lineares, 70-90 mu longae, 9 mu latae. Fructus ignotus."

frequently recurring terrestrial form of the species [*A. riparium*] with broad, short leaves and wide leaf cells." My first collection to be identified by Grout as *A. brevipes* was collected from the intake of a concrete water tank, in swift water shaded by a roof. This indicates that we have a taxon which is not wholly the result of its usual mesic habitat amongst scattered grasses in half-shaded lawns. On plate 15 of Grout's *Moss Flora*, vol. 3, figure A3 shows a "leaf of the broad-leaved *L. riparium* from Indiana, Welch." Figure B shows *L. brevipes* from West Virginia and Iowa. Obviously these are all members of the same taxon. Unfortunately, I believed for a long time that these mosses belonged in *A. laxirete* Card. & Thér., and so distributed and published them; a correction was published later (Conard, 1956).

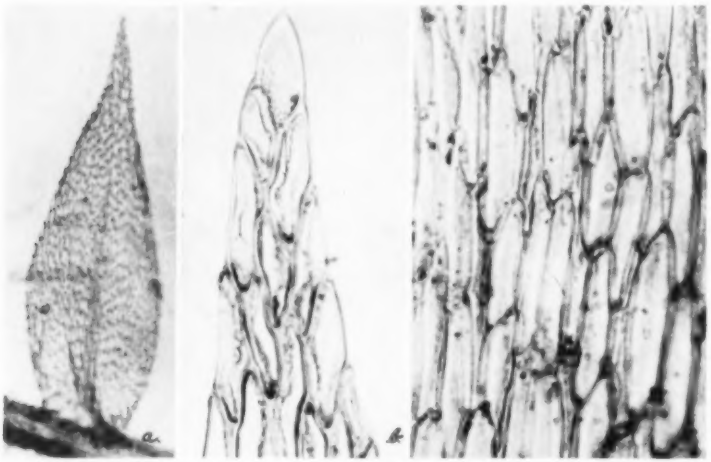

FIG. 1. *Amblystegium laxirete*. *a*. entire leaf. *b*. apex of leaf. *c*. median cells. (*a*, from Paris type; *b*, *c*, from Grout's portion of the type. Photographs by B. Lowy, to whom I extend thanks.)

The elegant figures of *A. riparium* on plate 42 of Jennings' *Manual* (1951) show plainly that he had "the frequently occurring terrestrial form," not the typical plant of the *Bryologia Europaea*. I have several collections of this form from Pittsburgh, Pennsylvania, taken by Joe Gergerich, who also was the first to discover *Fissidens exilis* in Pennsylvania.

If this taxon deserves a specific name it will be best to retain the epithet *brevipes*, since that was used by Grout (1931) as a subspecies, and by Conard (1956) and Welch (1957) as a species. Thus, *Amblystegium brevipes* Card. & Thér. in Holz. (1903) in-

cludes *A. brachyphyllum* Card. & Thér. (*l.c.*), *Leptodictyum riparium* var. *brachyphyllum* (Card. & Thér.) Grout (1931), *L. riparium* ssp. *brevipes* (Card. & Thér.) Grout (1931), *L. riparium* fo. *laxirete* sensu Conard (1945), not *A. laxirete* Card. & Thér. (1904), and *A. riparium* Hedw. in part, sensu Jennings (1931).

Amblystegium laxirete Card. & Thér. 1904 [*Leptodictyum laxirete* (Card. & Thér.) Broth.] was regarded by Grout as a form of *L. riparium*, differing from ordinary forms "in nothing but the somewhat shorter and broader leaf cells . . . and very soft, flaccid leaves." He cited the name as a synonym of *L. riparium*, with no taxonomic standing. Since no further description is given in Grout's *Moss Flora*, I give the original text below. [The species was described and illustrated by Welch (1957).]

> **Amblystegium laxirete** Card. & Thér., sp. nova.—E sectione *A. riparii*, sat robustum, fluitans, sordide viride, usque 10^{cm} longum, vage pinnatum, ramis inaequalibus patulis, attenuatis, laxe foliosis. Folia compressa, distiche patula, ovato-lanceolata, breviuscule acuminata, circiter 3^{mm} longa, 1^{mm} lata, marginibus planis integris, costa valida, 100 μ basi crassa, longe ultra medium evanida, rete laxo, cellulis 60–80 μ longis, 12 μ latis, parietibus angustis, mollibus. Caetera ignota. *Plate XXV.*
>
> Missouri: Monteer, in spring (B. F. Bush, 1899).
>
> The leaves shorter acuminate, the longer and thicker costa, and chiefly the loose areolation, at first sight distinguish this moss from *A. riparium*. The last character also separates it from *A. vacillans* Sulliv. From *A. Kochii* Br. Eur. it differs by its larger leaves and its much stronger and longer nerve.

"Monteer, in spring" refers to Rymer's Ebb-and-Flow Spring, seven miles northeast of Montier, Shannon County, Missouri. The spring was long an attraction to tourists because of its intermittent behavior. The nearest railway stations are Montier (spelling used in the *U. S. Postal Guide*) and Birch Tree.

The type of the species is in the Muséum National d'Histoire Naturelle in Paris. A fragment of the type and a slide are in the Grout Collection at Duke University, Durham, North Carolina. Mme. Allorge kindly loaned me a fragment of the type, which I studied and photographed—and returned.

I collected a quantity of this moss at Rymer's Spring. It forms streaming masses where the water from the spring enters the river (Jack's Fork). I have collected it in similar streaming masses in the outlets of several other large springs in southern Missouri. In the field it is very distinct in appearance, habit and habitat, re-

sembling *Fontinalis*, and differing widely from the forms *longifolium, flaccidum, fluitans* and *obtusum* of *Amblystegium riparium* as I have collected them.

By the way of comparison, the leaves of *A. laxirete* have the lanceolate outline, entire margins, spindle-shaped median cells, and enlarged quadrate basal cells of *A. riparium*. By contrast, the apex of *A. laxirete* is acute rather than acuminate. The terminal cell is but little exposed instead of longly exposed. Often two cells share the apex as in fo. *obtusum*. The midrib is long and strong, rather than short and weak. The median cells are 5-8 : 1, rather than 8-12(15) : 1. The lamina is twice as thick as in *A. riparium*. The leaves are complanate and approximate to overlapping. (Sporophytes have only recently been found, and will be described later by Paul Redfearn.)

In my opinion, the name *laxirete* is useful for designating the moss described above, as found in its special habitat at the outlet of large limestone springs. I have seen specimens from Texas (*Whitehouse*), Indiana (*Welch*), and Georgia, and am told that the species occurs in Arkansas.

I have compared the available forms of the North American *A. riparium* complex by means of formulae, using three characters. For characters of the type I use capital letters; for contrasting characters I use small letters. Thus, A = slenderly acuminate apex, ending in one long cell; a = merely acute apex, ending in 1 or 2 cells, mostly included. B = weak, short midrib; b = long, strong midrib. C = long, narrow median cells; c = broader cells (the source of the name *laxirete*). For extreme conditions the letters may be doubled.

I find the following formulae exemplified by specimens:

Large to Very Large Forms

ABC Amblystegium riparium (typical), Iowa (78 counties), Indiana (35 counties), Illinois, and other states.

AABC A. riparium fo. *elongatum; flaccidum*, Iowa (2 counties); *fluitans*, Iowa (2 counties), Indiana (9 counties), New York, and other states; *longifolium*, Indiana (5 counties).

ABBC not named, Illinois.

aaBC A. riparium fo. *obtusum*, Connecticut, Maryland, North Carolina, Florida.

AbC not named, Quebec, Arkansas, California, Idaho.

abc A. laxirete, Georgia, Indiana (5 counties), Kansas, Missouri, Texas.

Small Forms

ABC A. riparium var. *abbreviatum* of *Bryologia Europaea*, Iowa (2 specimens).

ABc not named, Ohio, Illinois, Missouri, Nebraska.

Abc not named, Pennsylvania, Ohio, Illinois, Nebraska.
aBCc (intermediate as to C) *A. brachyphyllum*, Minnesota.
aBc A. brevipes, Pennsylvania, Indiana (18 counties), Illinois, Iowa (33 counties), Missouri, Minnesota, Nebraska.
abC not named, Missouri.
abc not named, Ohio.

The method is not faultless. The characters grade into each other by such numerous and minute steps that the assignment of one letter or the other is often arbitrary. Any two or three combinations may be found in one woodlot. Nevertheless, I get in this way a more satisfying description of the conditions that actually occur.

Taxonomic Status

If we follow Grout's *Moss Flora*, we have to account for *Amblystegium riparium* (as *Leptodictyum*) and the "subspecies" *brevipes, sipho,* and *vacillans*. (If we use the category subspecies, typical *A. riparium* must be ssp. *riparium*.) It seems better, however, to grant specific status to *sipho, vacillans,* and *brevipes*. (*A. brachyphyllum* may well be placed as a synonym of *brevipes*.) With this simplification, I propose to arrange the available names as follows:

Amblystegium riparium (Hedw.) B. & S.
fo. *riparium* (typical), *ABC*.
fo. *abbreviatum* (B. & S.),[3] *ABC*, small.
fo. *elongatum* (B. & S.) Moenk., *AABC*.
fo. *flaccidum* (L. & J.),[3] *AABC*.
fo. *fluitans* (L. & J.),[3] *AABBC, ABBC*.
fo. *longifolium* (Schultz) Moenk., *AABC*.
fo. *obtusum* (Grout), *aaBC*.[3, 4]
Not named, *AbC*.
Amblystegium brevipes Card. & Thér. (*A. brachyphyllum* Card. & Thér.), *aBCc, aBc*.
Not named, *ABc, Abc, abC, abc*, small.
Amblystegium laxirete Card. & Thér., *abc*, large.
Amblystegium sipho (P-B.)[3] fide Grout, 1936.
Amblystegium vacillans Sull.

Other groups needing more detailed description are *A. serpens-juratzkanum-trichopodium*, and *A. varium-irriguum-fluviatile*. The place of *A. compactum* and its variety or form *americanum* needs review.

[3] These seem to be new combinations, but my name should not be attached to them, since I am simply following Grout.

[4] It may be noted that Grout (1917) issued var. *obtusum* under three numbers, 355, 465, and 471. The Latin diagnosis is printed on the label of no. 471, but no. 355 is there designated as the type. On the label bearing the Latin diagnosis "riperium" is a misprint. Also Dupret (1925) wrote "var. *obtusifolium*," and Grout (1927) himself wrote "fo. *obtusifolium*" for *obtusum*. These are clearly lapses.

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TWO NEW MOSSES FROM THE PHILIPPINES[1]

NIEVA E. VELOIRA

Two new species of mosses from the Philippines were recently discovered among numerous unidentified specimens which were kindly sent for study from the Philippine National Museum. One collection was easily classified as a *Taiwanobryum* after a comparison with *Taiwanobryum speciosum*, a Formosan species in the University of Tennessee Herbarium. *Taiwanobryum*, described

[1] Contributions from the University of Tennessee Botanical Laboratory, N. Ser. 201, and the University of the Philippines Natural Science Research Center.

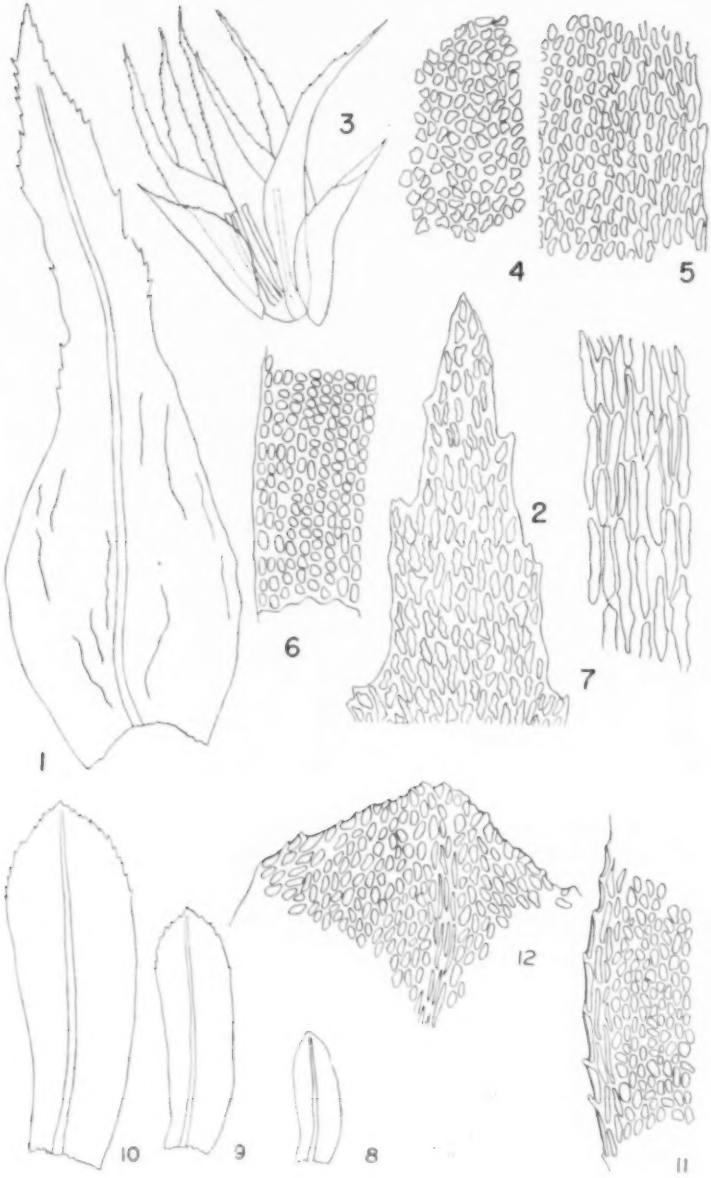
in 1936 by A. Noguchi, was first collected in Formosa in 1932 and was recently found by N. Takaki in Japan. This genus belongs to the family Prionodontaceae and resembles the genus *Prionodon* very closely. However, *Taiwanobryum* can be distinguished from the latter by the absence of papillae on the leaf cells; Noguchi pointed out the double peristome teeth of *Prionodon* as another major difference. Furthermore, the coarsely toothed leaf margin, the simple, shorter costa, and the oval-rectangular to elongate-hexagonal leaf cells suggest that the Philippine specimen is a *Taiwanobryum*. *Taiwanobryum robustum* is much more robust than *T. speciosum*.

In order that the description of the genus may be readily available, a translation from Noguchi's original Latin description (1936) is presented here.

Taiwanobryum Noguchi. Dioicous. Primary stem creeping, somewhat brownish-radiculose, laxly foliose, leaves minute, concave, broadly ovate, linear-lanceolate to subulate-attenuate, margins above minutely crenulate, costa slender, disappearing at 1/2 or 2/3 of the leaf, rarely none. Secondary stems distant from one another, flexuous when dry, arcuate-recurved above, in section elliptic or subrotund, without a central strand, very densely foliose, laxly branched, branches rather erect-spreading, above often arcuate, very densely foliose, linear-lanceolate-attenuate, apex rather obtuse, more or less simple. Cauline leaves of secondary stem oblong-ovate, base narrowly decurrent, lower part weakly plicate, in the middle canaliculate-concave and longitudinally rugose, margins flat above, with large and sharp, acute teeth. Costa slender, simple, disappearing far below the apex. Leaf cells hyaline, elongate-hexagonal or -rectangular, smooth, walls incrassate, somewhat subsinuose, basal cells elongate-rectangular, alar cells scarcely differentiated. Inner perichaetial bracts oblong-lanceolate, long-subulate-attenuate, costa to 2/3 of the leaf. Seta elongate, yellowish, mammillose. Capsule erect, yellowish, narrowly oblong-ovate, smooth. Peristome simple, with linear-lanceolate teeth, densely and minutely papillose throughout. Spores globose, densely and minutely mammillose.

Taiwanobryum robustum Veloira, sp. nov.[2] Plants robust, up to 15 cm. long. Primary stems creeping, hard, slender, laxly

[2] Planta robusta, ad 15 cm. longa. Caulis primarius repens, durus, gracilis, laxe foliosus, foliis minutis, concavis. Caules secondarii densiuscule foliosi, laxe ramosi. Folia caulina basi anguste decurrentia, 2-3.5 mm. longa et 1 mm. lata, ovato-lanceolata, valde plicata, marginibus irregulariter dentato-crenulatis ab apicem ad medium folii, marginibus basilaribus non dentatis. Cellulae folii laeves, parietes cellularum incrassati, elongato-hexagoni vel ovato-rectangulares. Cellulae in medio folii ovato-rectangulares, 20-35 μ × 5.5-8.5 μ, vel elongato-hexagonae ad margines, 30-50 μ × 5-7 μ. Cellulae basilares paulo diversae, elongato-hexagonae, 60-100 μ × 10-13 μ prope costam, rectangulares ad margines, 30-50 μ × 5-7 μ, luteae ad basim extremum. Costa gracilis, simplex, 60 ad 75 μ lata, evanida infra apicem. Apex folii planus, acuminatus, irregulariter dentatus. Bracteae perichaetii ovato-lanceolatae, denique acuminatae, crasse dentatae; cellulae elongato-hexagonae; internae bracteae perichaetii ad 1.8 mm. longae, externae bractae ad 1 mm. longae. Sporophyta ignota.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foliose; leaves minute, concave. Secondary stems densely foliose, laxly branched; leaves decurrent at the base (*fig.* 1), 2-3.5 mm. long and 1 mm. wide, ovate-lanceolate, strongly plicate; margin irregularly toothed to crenulate from the apex to about the midleaf; basal margin entire. Leaf cells smooth, cell walls incrassate, elongate-hexagonal to oval-rectangular. Cells of midleaf oval-rectangular, 20-35 μ × 5.5-8.5 μ, becoming elongate-hexagonal toward the margin, 30-50 μ × 5-7 μ. Cells of leaf base slightly differentiated, elongate-hexagonal, 60-100 μ × 10-13 μ near the costa, becoming rectangular toward the margin, 30-50 μ × 5-7 μ, yellowish-brown at extreme base. Costa slender, simple, 60-75 μ wide, vanishing below the apex. Leaf apex flat, acuminate, irregularly toothed. Perichaetial bracts (*fig.* 3) ovate-lanceolate, gradually acuminate, coarsely toothed; cells elongate-hexagonal. Inner perichaetial bracts up to 1.8 mm. long, outer bracts up to 1 mm. long. Sporophyte unknown.

Mindanao, Davao Province, summit of Mt. Kampalili, [definite substratum not specified], *G. E. Edano* 8754, March 23, 1949, TYPE (holotype in herb. University of Tennessee, isotypes in herb. A. Noguchi, the Philippine National Museum, and the University of the Philippines Herbarium).

The present species differs from *Taiwanobryum speciosum* of Formosa by the plants being about three times greater in diameter and in having coarser denticulation at the leaf apex (*fig.* 2). *T. speciosum* has a more or less regular leaf areolation throughout and more slender cells, 50-68 μ × 5.5-8.5 μ (measurements obtained from material collected Aug. 18, 1932, on Mt. Kodama by Noguchi). In contrast, *Taiwanobryum robustum* has irregular leaf areolation, 20-25 μ × 5.5-8.5 μ in the midleaf close to the costa, 30-50 μ × 5-7 μ toward the margin, 60-100 μ × 10-13 μ in the leaf base close to the costa (*fig.* 4-7).

An additional new species, *Thamnium quisumbingii*, was collected by G. E. Edano in 1951 at Mt. Purog, Samar. The material was thought at first to be a *Mniomalia* (Drepanophyllaceae) because of the thickened walls of the marginal cells. However, Mr. E. B. Bartram suggested that the material might be a *Thamnium*. Further studies on the specimen with the aid of other *Thamnium*

FIG. 1-9. *Taiwanobryum robustum*. 1. Leaf of primary stem, × 29. 2. Apical part of stem leaf, × 267. 3. Perichaetial bracts, × 37. 4. Midleaf cells close to the costa, × 267. 5. Midleaf cells close to the margin, × 267. 6. Basal cells showing the margin, × 267. 7. Basal cells close to the costa, × 267. FIG. 8-12. *Thamnium quisumbingii*. 8. Microphyllous leaf, × 39. 9. Secondary branch leaf, × 33. 10. Primary branch leaf, × 34. 11. Midleaf showing marginal cells, × 267. 12. Apical portion of branch leaf, × 267.

specimens from the Philippines reveal that this species is closely related to the endemic *Thamnium negrosense* Bartr. (1939).

Thamnium quisumbingii Veloira, sp. nov.[3] Plant with the characteristics of the genus, dendroid with a stipitate base, up to 10 cm. long, branching laxly with numerous flagelliform branchlets. Primary stem leaves larger, becoming microphyllous at the terminal part of the branches (*fig.* 8-10). Leaves slightly asymmetrical, bordered with 2 to 5 rows of narrowly elongated cells from insertion to near apex. Costa 8.5 μ to 23 μ at the base, ending at the apex. Sporophyte unknown.

Samar Province, Mt. Purog, [substratum not specified], *G. E. Edano* 15939, December, 1951, TYPE (holotype in herb. University of Tennessee, isotypes in herb. of E. B. Bartram, the University of the Philippines Herbarium, and the Philippine National Museum). Samar Province, Matuginao, [substratum not specified], *F. Cachalian* 15897, Jan. 2, 1952.

Thamnium quisumbingii is named for Dr. Eduardo Quisumbing of the Philippine National Museum, who sent the author valuable specimens for study. The new species resembles *Thamnium ellipticum* (Dozy & Molk.) Kindb. in the stipitate base and numerous flagelliform branchlets, but *Thamnium quisumbingii* has a less slender habit. The bordered leaves suggest a close relationship to *Thamnium negrosense*, but the present species has more elongate marginal cells (*fig.* 11) and a broadly obtuse leaf apex (*fig.* 12). Differentiated margins of *Thamnium negrosense* are two cells wide, while those of *Thamnium quisumbingii* are two to five cells wide.

The author is indebted to DR. EDUARDO QUISUMBING of the Philippine National Museum for sending the unidentified Philippine mosses, to DR. E. B. MAINS of the University of Michigan Cryptogamic Herbarium for lending identified specimens for comparison, and to MR. EDWIN B. BARTRAM and DR. AKIRA NOGUCHI for their helpful suggestions. I am grateful to DR. A. J. SHARP of the University of Tennessee for his encouragement and guidance in the preparation of the manuscript, and to DR. ARTHUR H. MOSER of the Classical Languages Department, University of Tennessee, for his help in the preparation of the Latin descriptions.

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[3] Planta cum formis generis, dendroidea cum base stipitata usque ad 10 cm. longa, laxe ramosa cum ramulis flagelliformis. Folii caulis primarii magni, deinde microphylii ad termina ramorum. Folii plus minus asymmetricus, ad margines 2 ad 5 series anguste elongatarum cellularum de interpositione fere ad apicem. Costa 8.5 μ ad 23 μ ad basim, evanida ad apicem. Sporophyta ignota.

NOTES ON HAWAIIAN HEPATICAE. III. RELATIONSHIPS AMONG HERPOCLADIUM, HERBERTA, AND ACROMASTIGUM

HARVEY A. MILLER and E. B. SCOTT[1]

The genus *Herpocladium* appears to have been misinterpreted since its description by Mitten (1871). The original diagnosis was based on *Herpocladium bidens* Mitt., considered endemic to the Hawaiian Islands. A second species, *H. tenacifolium* (Hook. & Tayl.) Mitt., from the southern hemisphere was assigned to the genus in Mitten's brief discussion. Later, Mitten added *H. fissum* from the Kerguelen Islands. Stephani added *H. antarcticum* from "Georgia Antarctica" and *H. sikkimense* from "Sikkim Himalaya." These five species constitute the genus as included in the *Species Hepaticarum*, except that *H. bidens* Mitt. is considered a synonym of *H. gracile* (Mont.) Steph. Since existing literature cites *Herpocladium bidens* Mitt. as a synonym of *H. gracile*, it is well to review briefly the history of these taxa. In 1843, Montagne described *Mastigophora* (Schisma) *gracilis* from Hawaii, and the species was illustrated the following year in the reports of the *Bonite* expedition. Although Montagne's material was male, only vegetative parts were figured. Initially, Stephani (1897) accepted *Herpocladium bidens* Mitt. as a valid species, though later (1909) he made *H. bidens* a synonym of *Mastigophora gracilis*, which he transferred to *Herpocladium*. Some points of Stephani's description of the genus (1909), *e.g.*, "Periantha ignota," and collections which he cited indicate that he probably had not examined Mitten's type or seen fertile material elsewhere. Evans (1934) described *Herpocladium* as having affinities with the Ptilidiaceae on the basis of the cross-section of a stem taken from the type of *Herpocladium bidens* (Evans, 1934, *fig.* 1). He apparently picked a strand from one of the packets of type material which agreed with his concept of *Herpocladium*, as the section figured agrees with Montagne's species. Nonetheless, Evans was not clear about the exact relationships of *Herpocladium* because the perianth "similar to that of *Lepidozia*" described by Mitten did not fit the general type found in the Ptilidiaceae. Schuster (1957) was also not clear about the status of *Herpocladium* but placed it under the Herbertaceae, following Müller, although he ventured

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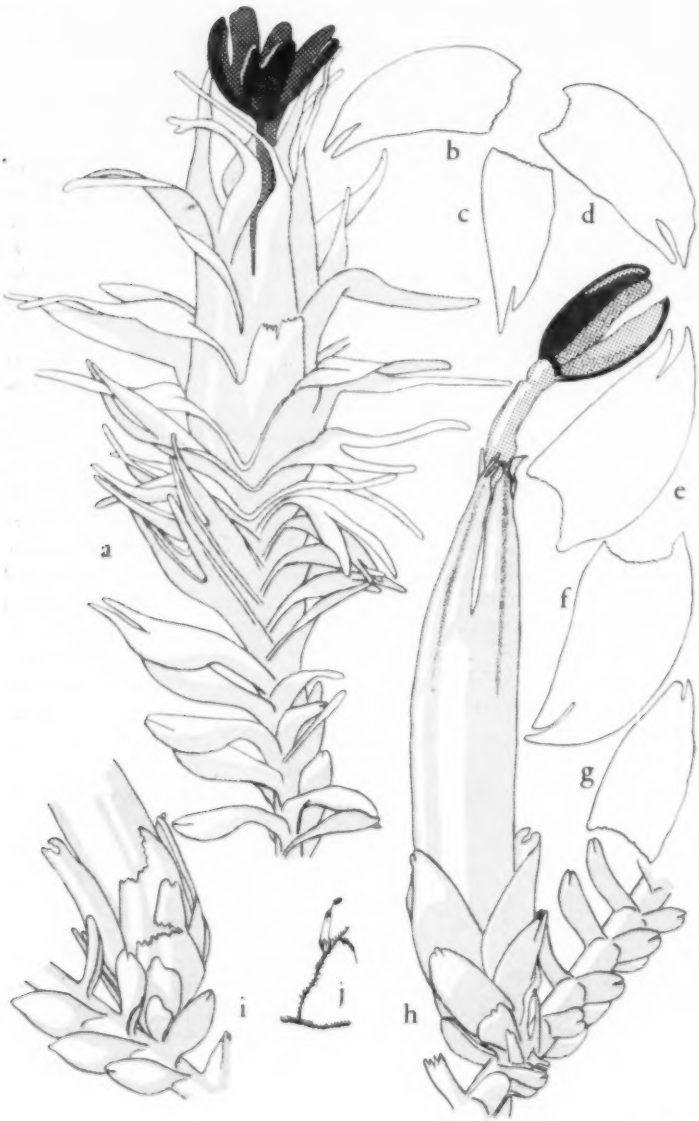


FIG. 1, *a-g*. *Herberta gracilis*. *a*. Mature perianth with sporophyte, × 21 (*Heller 2279*, NY). *b-d*. Whorl of leaves from type of *Mastigophora*

the opinion that it might be a primitive member of the Lepidoziaceae.

Examination of the type of *Herpocladium bidens* Mitt. has revealed that it is a mixture of two superficially similar species. The vegetative characteristics given in Mitten's description agree for the most part with *Mastigophora gracilis* Mont., and the description of the male branch can apply only to that species. However, the description of the perianth can apply only to the second species present—namely, *Acromastigum integrifolium* (Aust.) Evans (see *fig.* 1, *h-j*, drawn from Mitten's type).

Thus, it is necessary to select a portion of the original material as the type of *Herpocladium bidens* which is the type species of the genus. We considered selecting the perianth-bearing material as the generitype; this would make *Acromastigum* a synonym of *Herpocladium*. However, since Evans (1934) figured the stem cross-section of the *Mastigophora gracilis* element from Mitten's type collection of *Herpocladium bidens*, we feel that the selection has, in effect, already been made. Therefore, we consider the *Mastigophora gracilis* element to be the type of *Herpocladium* and have thereby avoided more than 30 new combinations. Professor Theodor Herzog (*in litt.*) independently suggested this course of action, and he concurs regarding the identity of elements present.

As *Herpocladium* is so poorly known, we have made a detailed study of the type species. As a result of this study we feel that *Herpocladium bidens* (*Mastigophora gracilis* Mont.) is a species of *Herberta* with some features which are perhaps anomalous in the genus as it is currently understood. Until the morphology of all species of *Herberta* is adequately known, however, it does not seem wise to separate *Herpocladium* (in the sense of the type species) from *Herberta*.

Herpocladium agrees with *Herberta* in that the capsule wall is five cells thick; the stem anatomy is of the *Herberta* type; "Gottsche thickenings" are present in cell walls; slime papillae are produced; the perianth is essentially indistinguishable from that of *Herberta;* a weak vitta is present; the seta is 32 cells in circumference; and the antheridial stalk is two cells in diameter. A feature anomalous for *Herberta* appears in the calyptra which is mostly 3-5 cells thick.

(Schisma) *gracilis* Mont. (PC), × 42. *e-g*. Whorl of leaves from type of *Herpocladium bidens* Mitt. (NY), × 42.—*h-j*. *Acromastigum integrifolium* from type of *Herpocladium bidens* Mitt. *h, i*. Fertile branch showing Mitten's "perianth similar to *Lepidozia*," × 21. *j*. Habit of fertile branch from Mitten's type, × 1.3.

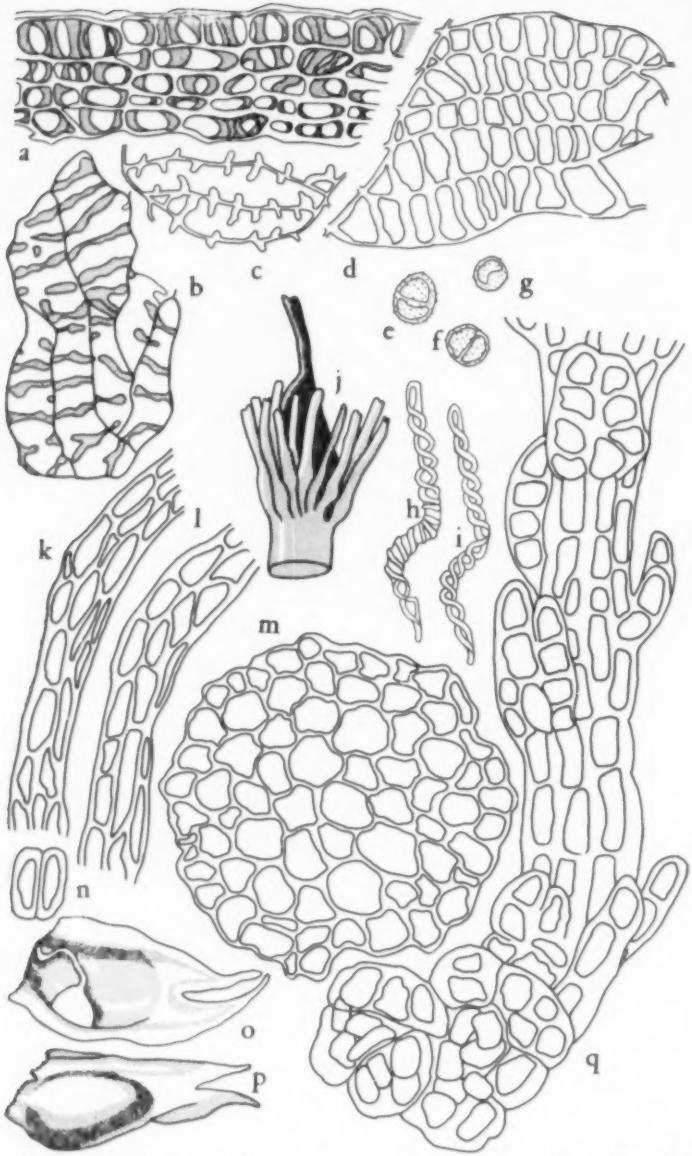
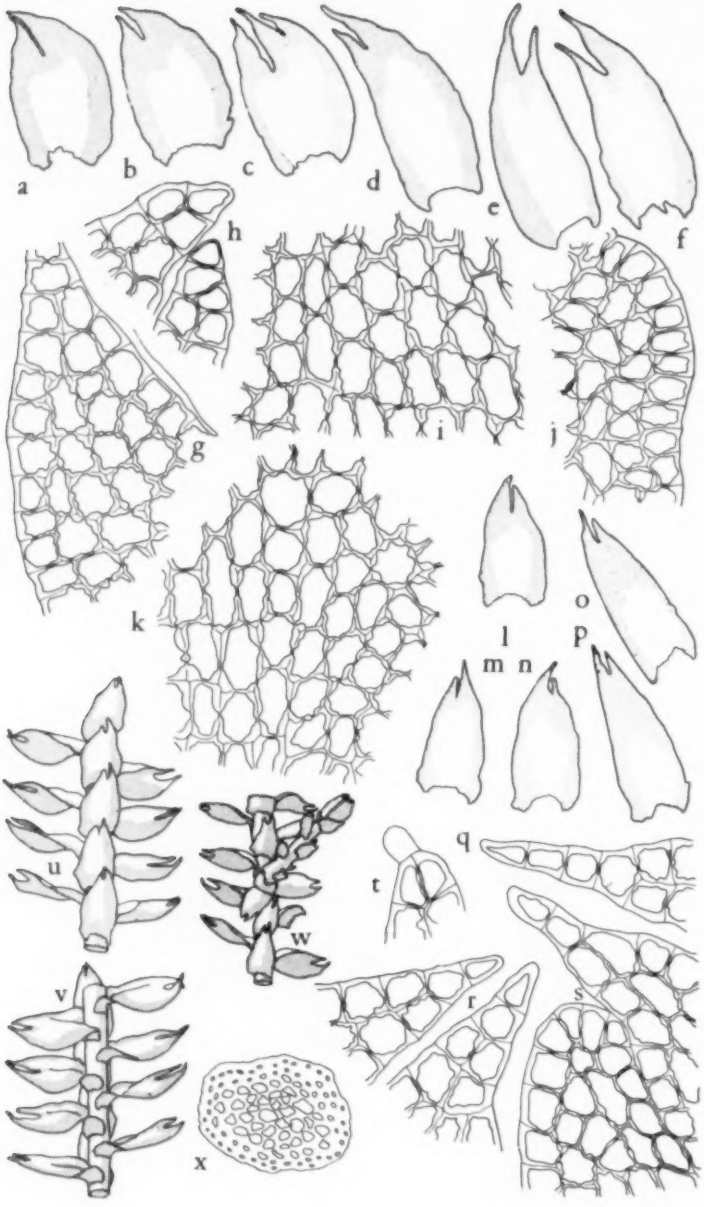


FIG. 2. *Herberta gracilis*. *a*. Transverse section, capsule, × 350. *b-d*. Cells from capsule, surface view, × 350. *e-g*. Spores, × 350. *h, i*. Elaters,

HERBERTA GRACILIS (Mont.) Steph. Bull. Herb. Boiss. 5: 842. 1897. *Mastigophora* (Schisma) *gracilis* Mont. Ann. Sci. Nat. 19: 254. 1843. *Sendtnera gracilis* (Mont.) G. L. N. Syn. Hep. 243. 1845. *Sendtnera tristicha* Aust. Proc. Acad. Nat. Sci. Phila. 24: 224. 1869. Herpocladium bidens Mitt. *in* Seemann's Fl. Viti. 405. 1871. (*p. p. maj.!*). *Herpocladium gracile* (Mont.) Steph. Sp. Hep. 3: 647. 1909. *Mastigophora parvifolia* Steph. *Ibid.* 6: 367. 1922 [*olim M. exigua* Steph. *in herb.*], *syn. nov.* *Mastigobryum biapiculatum* Steph. *Ibid.* 6: 455. (syn. nov.). Plants in mats or scattered among other bryophytes, medium coarse, greenish-yellow to deep brownish-black; stems to 15 cm. long, with leaves 0.5-1.5 mm. broad, ascending to erect, rigid, sparingly and irregularly branched, without paraphyllia, vegetative branches of the ventral intercalary type; the stem in transverse section of a cortical layer of 2-3 rows of cells with very thick walls and a medulla of larger cells with thinner walls and frequent pits; secondary stems developing from a rhizome; rhizoids colorless, from cells of the underleaves, sometimes from the leaves; stem leaves incubous, large, usually to 1/4-1/3 bifid (rarely trifid), asymmetrical, ovate-lanceolate, the vitta indistinct, shallowly concave, transversely inserted, mostly 0.8-1.3 × 0.4-0.5 mm.; the ventral side straight or somewhat rounded from a straight base, the margin usually possessing one or more evanescent slime papillae, often sessile, sometimes on the tips of more or less evident teeth or cilia; the dorsal side convex from a straight base, the margin as on the ventral side; the segments short to medium with the dorsal segment often the longer, ending in an uniseriate tip to 8 cells long, the end cell mostly 22-51 × 15-31 μ, often possessing a slime papilla; cells of the lamina tending to be in rows, the walls thick from thickenings deposited in bands ("Gottsche thickenings"), eventually becoming coalesced and lining the cell cavity which is angular-rounded, median cells from the upper portion of the dorsal segment averaging 32-34 × 21-26 μ, basal vitta cells averaging 40-42 × 21-25 μ, cells of the basal dorsal margin mostly 20-24 μ in diameter, cells between the margin and vitta mostly 22 μ in diameter; the cuticle striolate or verruculose; underleaves smaller than the leaves, similar, symmetrical; the lateral margins and segment tips often possessing slime papillae; the segments usually unequal in length, ending in a tip to 7 cells

× 350. *j.* Young sporophyte, with archegonia, × 42.5. *k, l.* Transverse sections, calyptra, × 350. *m.* Transverse section, sporophyte stalk, × 186. *n.* Transverse section, antheridial stalk, × 350. *o.* Male bract (vitta indicated), × 42.5. *p.* Male bracteole, × 42.5. *q.* Regenerant, × 350. Fig. a-i, k-m from *Heller* 2279 (NY); fig. j, n-q from *Miller* 2397.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long and 1-2 cells in diameter, or rounded; cells as in the leaf; leaves and underleaves of secondary stem branches, similar but smaller; dioicous; the male branches similar to vegetative branches, the male bracts usually in 5-12 pairs, concave, similar to the branch leaves, paraphyses not seen; bracteoles similar to the branch underleaves; antheridia 155-191 μ in diameter, subglobose to globose, solitary or in pairs in the axils of bracts and bracteoles; antheridial stalk 2 cells in diameter: archegonia in groups of 12 or more, the neck cells mostly in rows of 26 or more; female inflorescence a perianth of two coalesced leaves and one underleaf, split to 1/2 into six segments; perigonial bracts usually in 10 pairs, imbricated, increasing in size toward the perianth mouth; calyptra 2-5 cells thick; the sporophyte subglobose to globose, the stalk long, thick, of 32 cells in circumference; the capsule 4-valved (secondary splits often occurring), the wall of 4-7 cell-layers, thickenings in half rings across the inner tangential wall and in bands on radial walls; elaters long, bispiral, reddish-brown, 7-10 μ in diameter, the ends round or tapering; spores 15-20 μ in diameter, reddish-brown, round or oval, punctate; regenerants from leaves and underleaves radial, the first leaf bifid. (*Fig.* 1, *a-g; fig.* 2, *a-q; fig.* 3, *a-x.*)

Herberta gracilis is one of the more abundant species of Hepaticae found in the Hawaiian Islands and occurs on tree trunks, logs, or steep banks in wet forests at elevations of 1200 to 6000 ft. Generally it is mixed with other hepatics, such as *Bazzania, Herberta sanguinea, Acromastigum,* and *Anastrophyllum.* In the field it can be distinguished easily from *Herberta sanguinea* by its dark color and very squarrose leaves which possess a narrow, shallow sinus. Fertile material is not uncommon, although male plants are more abundant than female.

Significant collections examined: TYPE, *Mastigophora* (Schisma) *gracilis* Mont., Hawaiian Islands, *Gaudichaud* (PC); TYPE, *Herpocladium bidens* Mitt., *Hillebrand* (NY); TYPE, *Mastigophora parvifolia* Steph., Honolulu,

FIG. 3. *Herberta gracilis. a-f.* Stem leaves, × 28. *g.* Cells from the central portion of a dorsal segment, stem leaf, × 233. *h.* Cells of the ventral and dorsal segment tips, stem leaf, × 233. *i.* Cells from the basal portion of a dorsal segment, stem leaf, × 233. *j.* Cells from a portion of the basal dorsal margin, stem leaf, × 233. *k.* Cells from the central basal portion, stem leaf, showing the indistinct basal vitta on the left, × 233. *l-p.* Stem underleaves, × 28. *q.* Cells of the longer segment tip, stem underleaf, × 233. *r, s.* Cells of the segment tips, stem underleaves, × 233. *t.* Cells of a segment tip of an underleaf, showing a slime papilla, × 233. *u.* Portion of the secondary stem, ventral view, × 15.5 *v.* The same, dorsal view, × 15.5 *w.* The same, ventral view, showing ventral intercalary branching, × 15.5. *x.* Transverse section, secondary stem, × 124. Fig. a-c, g-n, q-x from *Miller* 2397; fig. d-f, o-p from *Heller* 2279 (NY).

Fleischer 79 [not Faurie!] (G); mature sporophytic material, Konahuanui, *Heller 2279* (NY); Tantalus trail to Konahuanui, 2000 ft. elev., *H. A. Miller 2397*. TYPE, *Mastigobryum biapiculatum* Steph., Hawaii, *Faurie* 584(G).

We have not attempted to account for all species referred to *Herpocladium*. However, it is clear from the descriptions and Stephani's manuscript drawings that a mass recombination with *Herberta* is not in order. For instance, Professor Herzog (*in litt.*) has indicated that *H. fissum* is a *Pachyglossa*. The other species will probably be assigned to related genera when further studies are completed.

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NOTES ON HAWAIIAN HEPATICAE. IV. HERBERTA HERPOCLADIOIDES SP. NOV.

E. B. SCOTT and HARVEY A. MILLER[1]

Herberta herpocladioides sp. nov.[2] Plants scattered among other bryophytes, small to medium, coarse, deep brownish-black, sometimes green toward tip of unexposed branches; stems to 4.5 cm. in length, to 2 mm. broad with leaves, ascending to erect, rigid, sparingly and irregularly branched, without paraphyllia, vegetative branches of the ventral intercalary type; the stem in transverse section of a cortical layer of 2-4 rows of cells with very thick walls and a medulla of larger cells with thinner walls and frequent pits; secondary stems developing from a rhizome; rhizoids colorless, from cells of leaves and underleaves: stem leaves large, to 1/2 bifid, asymmetrical-ovate, the vitta distinct, concave, canalic-

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[2] Plantae graciles, fusco-brunneae. Caule irregulariter pinnati. Folia squarrosa, magna, asymmetrica, ovata, concava, ad mediam bifida, lobis et sinu acutis. Cellulae foliorum membranis crassis, incrassationibus plerumque confluentibus. Cuticula verruculosa. Folia ventralia similia, sed minora. Reliqua desunt.

ulate, transversely inserted, mostly 1.0-1.1 × 0.6-0.8 mm.; the ventral side somewhat convex from a rounded base, the margin usually possessing one or more evanescent slime papillae, often sessile, sometimes on the tips of more or less evident teeth or cilia; the dorsal side convex from a rounded base, the margin as on the ventral side; the segments broadly acute with the dorsal segment the longer, ending in an uniseriate tip to 4 cells in length, the end cell mostly 23-26 × 20-30 μ, often possessing a slime papilla; cells of the lamina tending to be in rows, the walls thick from cell-wall thickenings deposited in bands, eventually becoming coalesced and lining the cell cavity which is angular-rounded, median cells from the upper portion of the dorsal segment averaging 38 × 28 μ, basal vitta cells averaging 45 × 23 μ, cells of the basal dorsal margin mostly 17-30 μ in diameter, cells between the margin and vitta mostly 18-31 μ in diameter; the cuticle striolate or verruculose: underleaves smaller than the leaves, similar, symmetrical; the lateral margins and segment tips often possessing slime papillae; the segments unequal in length, ending in a tip to 4 cells in length and 1-3 cells in diameter, or rounded; cells as in the leaf; leaves and underleaves of secondary stem branches similar but smaller; the remaining parts not seen. (*Fig.* 1, a-v.)

TYPE: Hawaii Island, Kohala Mountains Forest Reserve, waimea district, 4000 ft. elev., in bog-like cloud forest, June 19, 1953, *H. A. Miller* 4878, mixed with *Acroporium fuscoflavum* (BISH). PARATYPE: Kauai Island, Alakai Swamp trail, waimea district, 4000 ft. elev., December 25, 1952, *H. A. Miller* 2854A, mixed with *Jamesoniella macrophylla* and *Bazzania cordistipula*.

Both collections of this species were made in extremely wet and bog-like cloud forests characteristic of poorly drained mountain tops from 4000 to 6000 ft. in the Hawaiian Islands. In both cases, the material was rather sparse and grew entwined through a much more abundant species. Careful search through collections from the cloud forest may reveal that *Herberta herpocladioides* is not uncommon.

To the naked eye this species resembles *Herberta* (*Herpocladium*) *gracilis*, though the broader leaves with a well-defined vitta and open sinus distinguish it readily when viewed with a hand lens. It is because of the resemblance to Mitten's genus *Herpocladium* that we selected the specific name.

There is a possibility that Stephani saw this species for an illustration in his *Icones* labeled *Schisma pacificum* is very much like our species. However, we have been unable to locate his specimen, and the name was apparently never published.

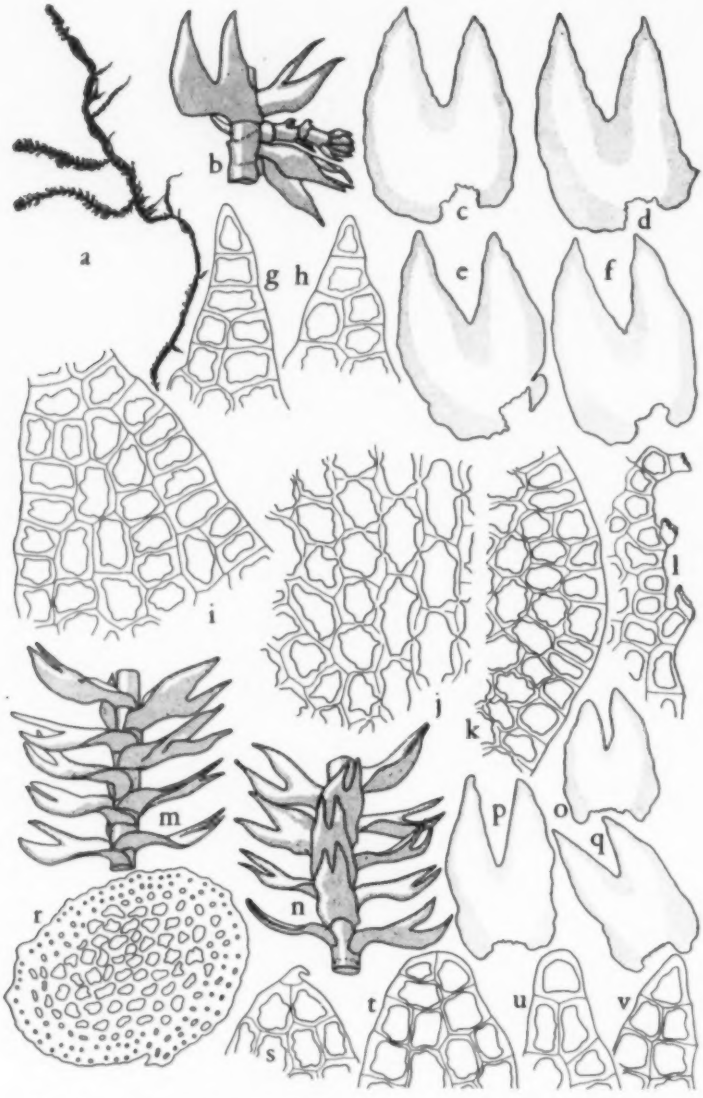

FIG. 1. *Herberta herpocladioides*. *a*. Habit, × 1.5. *b*. Portion of the secondary stem, showing ventral intercalary branching, × 15.5. *c-f*. Stem leaves (vitta indicated), × 28. *g*. Cells of a dorsal segment tip, stem leaf, × 233. *h*. Cells of a ventral segment tip, stem leaf, × 233. *i*. Cells from

A NATURAL HYBRID IN THE DITRICHACEAE

A. LeRoy Andrews[1] and Frederick J. Hermann[2]

On May 25, 1958, while collecting *Bruchia sullivantii* in a fallow clay field at the Plant Industry Station, Beltsville, Maryland, the junior author noted several plants of what at first sight appeared to be an over-developed *Pleuridium subulatum* in a nearly bare spot amidst grasses. The most striking anomaly of these plants lay in the much elongated (up to 3 mm.) and unusually stout seta, which was generally more or less arcuate or recurved. Furthermore, the more mature capsules showed a distinct dark ring below the apex, suggesting an operculum, although no sign of dehiscence was noted. The anomalous plants, about 40 in number, all occurred within an area about six to eight inches in diameter among a rather dense stand of *Pleuridium subulatum* and *Ditrichum pallidum*. Other associated mosses were *Physcomitrium pyriforme*, *Bruchia sullivantii*, *Leptodictyum trichopodium*, and *Pottia truncata*. A thorough search of the surrounding area, both on May 25 and later in 1958, revealed no further plants of the *Pleuridium*-like moss with elongated setae. But on April 18, 1959 five additional nearly mature sporophytes were found at the same locality, besides several very immature ones readily recognizable by the thickened setae, although their tips were only just beginning to expand to form the capsule. These sporophytes still bore calyptrae, which in the 1958 collection had fallen. In the more nearly mature capsules of the 1959 collection the operculum was conspicuously demarcated by a constriction of the urn at the line of juncture and also by its golden-brownish color in contrast to the pale green of the spore-filled urn. The plants were ultimately determined as bearing hybrid sporophytes between the *Pleuridium* and *Ditrichum* with which they were growing. The description follows, that of the gametophyte being perhaps unnecessary as it is quite that of the *Pleuridium*.

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[2] Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, Beltsville, Md.

an upper portion of a dorsal segment, stem leaf, × 233. *j*. Cells from the central basal portion, stem leaf, showing the basal vitta on the right, × 233. *k*. Cells from a portion of the basal dorsal margin, stem leaf, × 233. *l*. A portion of the dorsal basal margin showing the former attachment of slime papillae, × 233. *m*. Portion of the secondary stem, dorsal view, × 15.5. *n*. The same, ventral view, × 15.5. *o-q*. Stem underleaves, × 28. *r*. Transverse section, secondary stem, × 124. *s*. Cells of a shorter segment tip showing a slime papilla, stem underleaf, × 233. *t*. Cells of the shorter segment tip, stem underleaf, × 233. *u, v*. Cells of the longer segment tips, stem underleaf, × 233. (Drawn from *Miller* 4878.)

× **Pleuriditrichum marylandicum** hybr. gen. et spec. nov.[3] [Pleuridium subulatum (Hedw.) Lindb.[4] × Ditrichum pallidum (Hedw.) Hpe.] Plants minute, gregarious, dark yellow-green, 3-4 mm. high (including sporophyte); stem erect, short, 1-2 mm. high, usually simple, sometimes branched at the base; lower leaves lanceolate-subulate, spreading, 0.5-1 mm. long, the upper erect-ascending, long (1-2 mm.) and subulate-acuminate, from an ovate-lanceolate base, concave; costa stout, often occupying 1/3 of the base and all of the apex, excurrent, serrulate toward the tip; leaf-cells rectangular, the upper linear, the alar not appreciably enlarged.

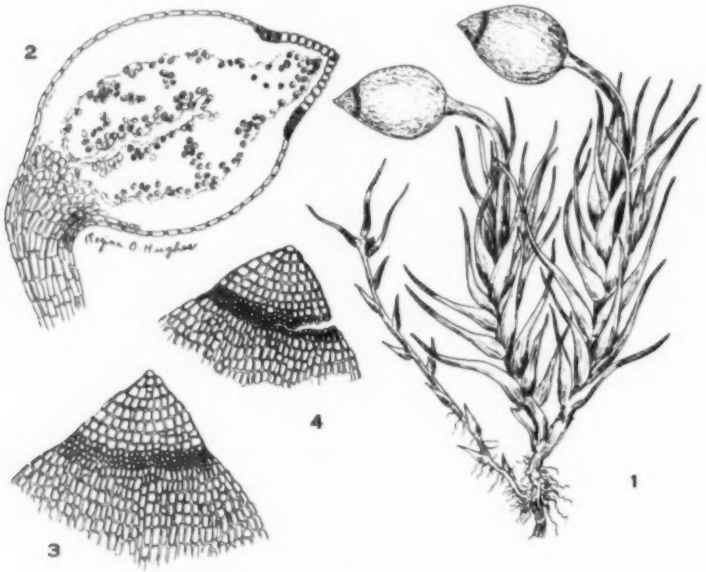

FIG. 1-4. *Pleuriditrichum marylandicum*. 1. Habit, × 20. 2. Capsule in optical section, × ca. 80. 3-4. Exothecial cells in opercular region, × ca. 80.

[3] Seta elongata, 1.5-3 mm. longa (capsula 2-4-plo longior), crassa, ca. 175 μ diametro, plus minusve contorta, plerumque cernua; capsula ovoidea vel breviter conica, basi truncata, apice obtuse apiculata, 0.6-1 mm. longa, maturitate rubro-brunnea, operculo vix dehiscenti; peristoma nullum; sporae 15-25 μ diametro, brunnescentes, papillosae; calyptra cucullata.

[4] It is expressly to be noted that the *Pleuridium* is the *P. subulatum* (Hedw.) Lindb. of Grout's *Moss Flora*, previously known under the older name *P. alternifolium* (Dicks.) Rabenh., not the older *P. subulatum* (Huds.) Rabenh., which appears in Grout's *Flora* under the later name *P. acuminatum* Lindb.

Autoicous; seta elongate, 1.5-3 mm. long (2 to 4 times the length of the capsule), relatively stout, about 175 μ in diameter, more or less twisted, generally arcuate or recurved; capsule sometimes ovoid but usually short-conic with truncate base, bluntly apiculate at the apex, 0.6-1 mm. long, reddish-brown when mature, the apical 1/4 differentiated as a scarcely dehiscent operculum, the region of dehiscence forming a darker band with much smaller cells than the exothecial cells below and the opercular cells above; stomata at base of urn; peristome none; spores 15-25 μ in diameter, brownish, papillose; calyptra cucullate. *F. J. Hermann* 14328 (US-type; CAN; DUKE; NY) and 15099 (US).

Hybridism between related species of mosses has been demonstrated artificially, and that it occurs in nature where related species grow in close association is beyond doubt. The clearest observed cases are those where cleistocarpous species cross with others of the same family having a more highly developed sporophyte. The intermediate character of the hybrid sporophyte is in these cases so evident that it can hardly escape the attention of a careful observer. That these have to pass as intergeneric hybrids need not strain one's credulity too much as moss genera are in some cases still artificial, and the species involved might usually, on the basis of similar gametophytes, be regarded as after all congeneric. The time has long passed when the cleistocarpous mosses were thought to be a group by themselves, though still maintained in such important works as those of Limpricht and Roth. That they represent members of diverse families with sporophytes simplified by reduction rather than primitive types is now so universally agreed that it hardly calls for discussion.

The families in which such natural hybrids between cleistocarpous species and those with more highly developed sporophytes have been described are the Funariaceae, the Ditrichaceae and the Pottiaceae.[5] For the artificial demonstration of the possibilities of such hybridism in the Funariaceae, the remarkable experiments of Wettstein[6] may be consulted.

To confine ourselves to the Ditrichaceae, the classical European examples are the two forms found by Breidler and regarded by

[5] The *Astomum-Weisia-Trichostomum* complex. The present senior author has not yet entirely given up the idea that the moss appearing in Grout's *Moss Flora* as *Astomum phascoides* (Hook.) Grout is a natural hybrid between the *A. Muhlenbergianum* (Sw.) Grout and *Weisia viridula* [L.] Hedw., with which it is often associated in herbarium specimens. See F. von Wettstein, Bibliographia Genetica 1: 10f. 1925 for list of earlier described hybrids.

[6] Zeitschr. f. indukt. Abstamm.- und Vererbungslehre 33, 1924; Bibliotheca Genetica 10, 1928.

him as hybrids, described by Limpricht, who was skeptical of their hybrid character, as *Ditrichum Breidleri* and *D. astomoides*.[7] *D. Breidleri*, according to its discoverer, was a hybrid between *Sporledera palustris* ♀ (*Pleuridium palustre* of Grout) and *Ditrichum pallidum* ♂, with both of which it was growing. *D. astomoides* was a hybrid between *D. pallidum* ♀ and *Pleuridium subulatum* ♂ (*P. acuminatum* of Grout), with both of which it was growing. Neither then corresponds exactly to the present hybrid. Its general appearance is similar to the former of the two European ones, according to Limpricht's illustrations. Mönkemeyer[8] speaks of one or two later findings of both European forms, growing with the same presumptive parents, one of which finds he had been able to see himself, but like Limpricht he was also skeptical about their hybrid nature. The close relationship of *Ditrichum pallidum* with the *Pleuridium* species has been confirmed cytologically by Mrs. Virginia S. Bryan,[9] who found the chromosomes of all lying consistently in the $n = 13$, 26 series and otherwise similar. A European hybrid sporophyte between the non-American *Ditrichum subulatum* (Bruch) Hpe. and *Pleuridium subulatum* (*P. acuminatum* of Grout) described by Venturi[10] is of interest, but has less immediate relation to the one now being described. The present form differs appreciably from the *Ditrichum Breidleri*, which it otherwise greatly resembles, by a complete lack of peristome. Limpricht figured for the European form a rudimentary peristome of the *Ditrichum* type, which however was enclosed and apparently, through failure of automatic dehiscence of the operculum, non-functioning. The spores of the present hybrid vary greatly in size even in the same capsule, fluctuating between the smaller size of those of the *Ditrichum* and a larger size hardly or rarely reaching that of the *Pleuridium* spores. At least a large proportion of the spores appears to be defective. No attempt was made to germinate them. Wettstein found different degrees of sterility, often high, sometimes complete, among the spores of his various hybrids.

[7] Laubmoose 1: 508 and 511. 1887.
[8] Die Laubmoose Europas 4 (Ergänzungsband): 156. 1927.
[9] Amer. Jour. Bot. 43: 460ff. 1956.
[10] Rev. Bryol. 8: 20ff. 1881. Venturi already at this early date championed the concept of the distribution of the cleistocarpous mosses among the families with which they are naturally related and gave especial credit to Lindberg in this connection. Lindberg had in fact in his invaluable Musci Scandinavici of 1879 so arranged the European Cleistocarpi and had already recognized the close relationship of *Pleuridium* with *Ditrichum*.

NEW OR INTERESTING PARMELIAS FROM NORTH AND TROPICAL AMERICA[1]

MASON E. HALE, JR.[2]

In the following notes ten species of *Parmelia* are discussed with special reference to their typification, synonymy, and distribution. Four new species, *P. allardii*, *P. epiclada*, *P. phlyctina*, and *P. subinvoluta*, a new variety, *P. epiclada* var. *laciniata*, and a new name, *P. norstictica*, are proposed.

1. **Parmelia allardii** sp. nov. Thallus usque ad 15 cm. latus, glaucescenti-albidus, irregulariter lobatus, substrato laxe adnatus, lobis 6-12 mm. latis, 15-20 mm. longis, 0.10-0.14 mm. crassis, superne laevigatus, parce isidiatus, margine quamvis dense isidiatus, breviter laceratus, isidiis cylindricis vel tandem complanatis, coralloideis, 0.1-0.2 mm. diametro, 1-3 mm. altis, plus minusve ciliatis, aliquando in soredia fatiscentibus, margine loborum etiam ciliato, ciliis 2-3 mm. longis, KOH+ caeruleis vel KOH—, medulla alba, subtus in centro niger, rhizinibus concoloribus munitus, ambitum versus nudus, castaneus vel albido- et castaneo-variegatus. Apothecia rara, 4-10 mm. lata, demum planiuscula, subpedicellata, imperforata, excipulo isidiato, amphithecio rugoso; hymenium 80-90 μ altum; hypothecium 30-35 μ crassum; sporae octonae, 10-14 × 16-20 μ, episporio tenui; pycnidia rara, conidiis non visis. Thallus KOH+ lutescens, medulla K—, C—, KC+ erythrinosus, P—, atranorinum et acidum alectoronicum continente.

Type in the U. S. National Herbarium, vicinity of Constanza, La Vega, Dominican Republic, *H. A. Allard* 16529, October 28, 1947.

Representative specimens examined. VIRGINIA: 10 mi. E. of Fancy Gap, Carroll Co., *Hale* 12862 (US). TENNESSEE: Backbone Rock, Johnson Co., *Hale* 18410 (US). ALABAMA: Cheaha State Park, Cleburne Co., *Hale* 7066 (US). GEORGIA: 4 mi. W. of Midway, Liberty Co., *Hale* 16811 (US). FLORIDA: 5 mi. S. of Silver Glenn Springs, Marion Co., *Hale* 17594 (US). CUBA: Region of La Bayamesa, Oriente, *Morton* 9603 (US). JAMAICA: Sugar Loaf, Blue Mountains, *Imshaug* 15435 (MSC). VENEZUELA: Maracay, Aragua, *Mägdefrau* 314, 404 (M). FORMOSA: Keitau, *Asahina* F.451 (US).

Parmelia allardii (*fig.* 1) is a very variable species reaching greatest development in the American tropics where it has previ-

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[2] Smithsonian Institution, Washington 25, D. C.

ously been called *P. proboscidea* var. *corallina* Müll. Arg. or *P. crinita Ach.* The predominantly marginal isidia are always recognizable, yet the range of variation, from rather inconspicuous sorediate isidia to the large ciliate coralloid clusters, is so great that one would justifiably hesitate to place extreme examples under the same species. The characters that are common to the extremes are production of alectoronic acid and the abundant, usually KOH+ blue cilia. No other isidiate Parmelias are known to produce alectoronic acid.

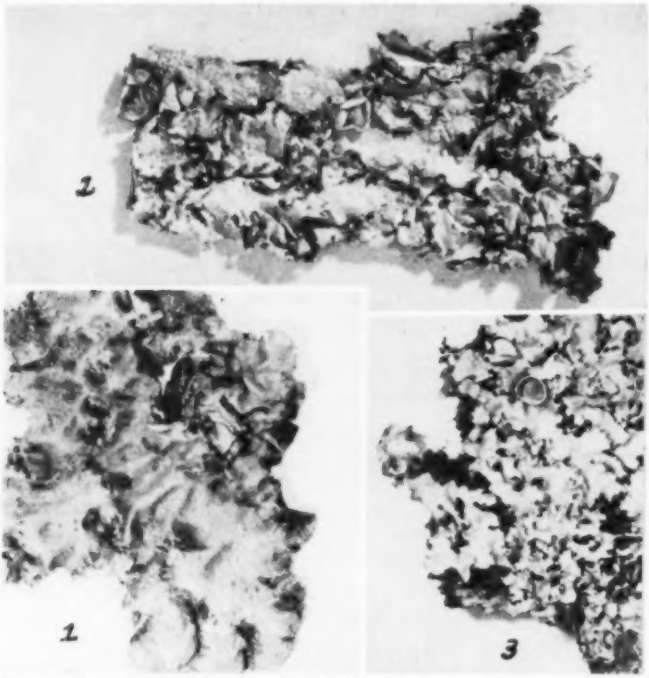

FIG. 1. *Parmelia allardii* (*Asahina* F.451), ×1. FIG. 2. *Parmelia phlyctina* (*Imshaug* 14908), × 1. FIG. 3. *Parmelia epiclada* (*Hale* 17654), × 1. (Photographs by the Smithsonian Institution.)

2. PARMELIA BORRERI (Sm.) Turn., Trans. Linn. Soc. 9: 148, *tab.* 13, *fig.* 2. 1808. *Lichen borreri* Sm., Eng. Bot. 25: 1780. 1807. *Parmelia dubia* (Wulf. in Jacq.) Schaer., Lich. Helv. Spic. 10: 453. 1840, non *Parmelia dubia* (Ach.) Floerke, Deutsch. Lich. 4: 9. 1819 (= *Physcia dubia*). The morphology and systematic position of *Parmelia borreri* (as *P. dubia*) has been

rather fully investigated by Culberson and Culberson (1956). A correction in nomenclature, however, is in order since *Parmelia dubia* (Wulf. in Jacq.) Schaer., is a later homonym. The species has been illustrated in color by both Smith (as *Lichen borreri*) and Wulfen (as *Lichen dubius*), and there seems to be no doubt of its identity. A specimen collected and identified by Turner in England (near Yarmouth, Norfolk, US) contains lecanoric acid and agrees in other respects with the accepted concept of the species. *Parmelia borreri* is a common corticolous lichen in the western United States and in the Appalachian Mountains westward to Ohio, becoming very rare in the Great Lakes region. Its relation to *P. flaventior* Stirt., a yellow species with a more restricted distribution, is discussed below.

3. **Parmelia epiclada**, sp. nov. Thallus adpressus, irregulariter expansus, 5-15 cm. latus, cinereo-albicans, lobis elongatis, subimbricatis, 4-10 mm. latis, 10-20 mm. longis, 0.11-0.20 mm. crassis, superne planus, laevigatus, tandem nonnunquam partim inaequaliter rimulosus, nec maculatus, nec isidiatus esorediatus, margine integro vel brevissime subdenticulato laciniato, laciniis 1-3 mm. longis, parce ciliato, ciliis 1-3 mm. longis, KOH—, medulla alba, subtus niger, rhizinibus munitus, in peripheria anguste glaber, castaneus, rugulosus, nitidus. Apothecia valde evoluta et numerosa, valde pedicellata, imperforata, disco primum urceolato aut demum plano, amphithecio rugoso et albido-maculato, excipulo rare dentato; hymenium 40-50 μ altum; hypothecium 13-17 μ crassum; sporae octonae, 6-8 × 12-16 μ; pycnidia numerosa in lobis laciniisque, conidiis rectis, 5-7 μ longis. Thallus KOH lutescens, medulla K—, C—, KC+ roseus, P+ aurantiacus, atranorinum et acidum protocetraricum continente.

This unique species bears closest resemblance to *P. eciliata* (Nyl.) Nyl., a widespread lichen of tropical America. Both plants have similar lobation, but *P. eciliata* is more loosely adnate and has a mottled white and brown zone at the margin below and longer cilia. The apothecia are identical, but the spores of *P. eciliata* (type: Mexico, *Bourgeau*, Nylander herbarium no. 35295, H) are about twice the size of those in *P. epiclada:* 14-16 × 23-28 μ. *Parmelia eciliata* also produces stictic rather than protocetraric acid.

Parmelia epiclada is one of the commonest Parmelias in the southeastern United States on the upper trunks and branches of deciduous trees, especially the southern red oaks. It has not come to the attention of lichenologists probably because of the paucity of herbarium collections from this region in herbaria. There are

several specimens from Massachusetts in Willey's herbarium (US), which obviously puzzled Willey. According to his notes, Tuckerman called the material *P. cetrata* Ach., and Nylander identified it as *P. tiliacea* Ach. The former species is similar in size but differs in having a reticulately cracked cortex, rhizines to the margin below, and salacinic acid (K+ red). *Parmelia tiliacea* is an unrelated European lichen. It is surprising that *P. epiclada* has not yet been collected in the West Indies or Central America, since it is so common in the southern United States.

Type in the U. S. National Herbarium, Suwannee River State Park, Suwannee Co., Florida, *Hale* 17654, April 20, 1958 (*fig.* 3).

Representative specimens examined. MASSACHUSETTS: New Bedford, *Willey* (US). NEW JERSEY: Pennsville, Salem Co., *Commons*, Sept. 17, 1896 (PH). DELAWARE: Ruthby Station, *Commons*, June 10, 1895 (PH). MARYLAND: Near Lusby, Calvert Co., *Hale* 14359 (US). VIRGINIA: Skinquarter, Chesterfield Co., *Hale* 14590 (US). NORTH CAROLINA: 11 mi. N. Burlington, Alamance Co., *Hale* 16362 (US); 6 mi. W. of Durham, Durham Co., *Culberson* 7826, 7828 (DUKE). SOUTH CAROLINA: Windsor, Aiken Co., *Hale* 7607 (US). GEORGIA: Claxton, Evans Co., Hale 7445 (US). FLORIDA: Highlands Hammock State Park, Highlands Co., *Hale* 16957 (US); Sanford, Seminole Co., *S. Rapp*, Aug. 1927 (FLAS). ALABAMA: Pell City, St. Clair Co., *Hale* 7243 (US). MISSISSIPPI: Ackerman, Choctow Co., *Hale* 7785 (US). LOUISIANA: Benton, Bossier Par., *Hale* 5645 (US); near Alexandria, Rapides Par., *Logan* 881 (WIS). ARKANSAS: Near Bradley, Lafayette Co. *Hale* 5598 (US). TEXAS: Avinger, Cass Co., *Hale* 5268 (US).

3a. PARMELIA EPICLADA var. **laciniata**, var. nov. Statura thalli, materia chemica, et sporae sicut in *P. epiclada* var. *epiclada* sed differt margine dense laciniato, laciniis 2-3 mm. latis et usque ad 10 mm. longis.

Type in the U. S. National Herbarium, near Rosney, Buckingham Co., Virginia, *Hale* 15970, March 19, 1958.

Specimens examined. NORTH CAROLINA: 2 mi. S. of Leaksville, Rockingham Co., *Hale* 16422 (US). FLORIDA: 5 mi N. of Pittman, Lake Co., *Hale* 17499, 5 mi. S. of Lokosee, Osceola Co., *Hale* 16971 (US).

This is a well-marked variety, much rarer than the typical variety, usually found at the base of trees in the open and loosely attached rather than adnate.

4. PARMELIA FLAVENTIOR Stirt., Scot. Nat. 4: 254. 1877-78. *P. andreana* Müll. Arg., Rev. Mycol. 1: 169. 1879. *P. kernstockii* Lynge & Zahlbr., Ann. Nat. Hofmus. Wien 27: 271. 1913. The identity of *P. andreana* and *P. kernstockii* was first noted by Santesson (1944, p. 19). However, *P. flaventior* Stirt., described from "The Brazils," is the oldest available epithet for this entity and must replace the currently accepted *andreana*. The types of

all three species are identical in morphology (pseudocyphellate, marginally sorediate, dark brown to black below and erhizinate at the margin) and in chemistry (lecanoric and usnic acids, atranorine, medulla C+ red).

Few species have attracted so much interest as *P. flaventior*. Its European and South American distributions (as *P. andreana*) are well known (cf. Santesson, 1944; Maas Geesteranus, 1947). Culberson and Culberson (1956) briefly give its distribution in North America as California and, more rarely, eastern United States. I have recently collected the species commonly from northern Georgia to New York in the Appalachian Mountains and in the Great Lakes region. *Parmelia flaventior* is in reality a widespread species in mountainous and subboreal regions in North and South America and Europe. Culberson and Culberson (1956) reduced *P. flaventior* (*P. andreana*) to synonymy under *P. dubia* (Wulf.) Schaer, as a chemical strain. I cannot agree with this arrangement. *Parmelia flaventior* has the dark underside and broad naked marginal zone below typical of the section *Amphigymnia*. While *P. dubia* (= *P. borreri*) may mimic *P. flaventior* in size, it will invariably be found to have a pale underside with rhizines extending to the margins, and it lacks the yellow color caused by usnic acid.

Representative specimens examined. CANADA: Whitefish Bay, Kenora, Ontario, *Cain* 26404 (US). NEW YORK: 8 mi. SE. of Quaker Bridge, Cattaraugus Co., *Hale* 16679 (US). PENNSYLVANIA: Shawnee State Park, Bedford Co., *Hale* 19247 (US). MARYLAND: 1 mi. E. of Oldtown, Allegheny Co., *Hale* 14481 (US). WEST VIRGINIA: Huttonsville, Randolph Co., *Hale* 12498 (US). MICHIGAN: Frederic, Crawford Co., *Hale* 11073 (US). WISCONSIN: Tower Hill State Park, Iowa Co., *Culberson* 3318 (US, WIS). VIRGINIA: Crescent Rocks, Page Co., *Hale* 18136 (US). NORTH CAROLINA: Sparta, Alleghany Co., *Hale* 8086 (US). TENNESSEE: 2 mi. N. of Carters Gap, Carter Co., *Hale* 18007 (US). GEORGIA: Near Chatsworth, Murray Co., *Hale* 7406 (US). MEXICO: without locality, *E. Palmer* (US). COLOMBIA: Laguna "La Herrera," Mosquera, Cundinamarca, *García-Barriga* 10911 (US). PERU: Cuzco, *Herrera* 1594 (US). ECUADOR: Cisne, *André* 4311 bis (US, isotype of *P. andreana* Müll. Arg.). "THE BRAZILS": *Weir*, 1877 (GLAM, holotype of *P. flaventior* Stirt.). BOLIVIA: Base of Mt. Illimani, Río Palca Valley, *Bro. Julio* 101 (US). CHILE: Valparaiso, *Fr. Joseph* 3777 (US). EUROPE: Between Lengmoos and Klobenstein, Austria, *Krypt. Vind. Exs.* 2071 (US, isotype of *P. kernstockii* Lynge & Zahlbr.).

5. PARMELIA MACROCARPOIDES Vain. fo. SUBCOMPARATA Vain., Acta Soc. Faun. Fl. Fenn. 7: 43. 1890. This form differs from the typical variety in having soredia. It may be desirable to recognize it as a distinct species, but Vainio's type specimens are so scrappy that it is very difficult to reach a decision. Forma *sub-*

comparata, known previously only from Brazil, is actually quite common in the West Indies and occurs rarely in the southern United States and Central America. It differs from *P. reticulata* Tayl. in having more strongly laciniate lobes and in producing atranorine and a fatty substance (thallus K+ yellow, medulla K−, C−, KC−, P−). *Parmelia reticulata* has fewer laciniae and produces salacinic acid (medulla K+ red). Both species have a reticulately rimose upper cortex as in typical *P. cetrata* Ach.

Specimens examined. TENNESSEE: Backbone Rock, Johnson Co., *Hale* 18034a (US). DOMINICAN REPUBLIC: Vicinity of Constanza, La Vega, *Allard* 16356, 17442, 17679 (US). GUATEMALA: Near Cobán, Verapaz, *Standley* 71818 (F). BRAZIL: Sitio, Minas Gerais, *Vainio* 918 (FH, lectotype).

6. PARMELIA MADAGASCARIACEA (Hue) des Abb., Bull. Inst. Fr. Afr. Noire 20: 22. 1958. *P. caperata* var. *madagascariacea* Hue, Lich. Extra-Europ. 181. 1899. *P. chrysantha* Tuck. in herb. (listed as a synonym of *P. sulphurata* in N. A. Lichens, 55. 1882). This species is quite common on trees and sandstone boulders in southern United States, but also occurs in Madagascar and Central America. It is a member of the *P. xanthina* group, which includes *Amphigymnia* species with isidia, cilia, and usnic acid (cortex yellow). The nomenclature and chemical variation of this primarily tropical group are not yet fully understood. *Parmelia madagascariacea* reacts K−, C−, KC+ red, P− in the medulla, containing usnic acid and an unknown KC+ substance.

Specimens examined. KENTUCKY: Natural Bridge State Park, Powell Co., *Hale* 13780 (US). VIRGINIA: 10 mi. E. of Fancy Gap, Carroll Co., *Hale* 18437 (US). NORTH CAROLINA: Near Candler, Buncombe Co., *Green*, March 1958 (US). SOUTH CAROLINA: 10. mi SW. of Walterboro, Colleton Co., *Hale* 16597; near Greenville, Greenville Co., *Hale* 7753 (US). TENNESSEE: Backbone Rock, Johnson Co., *Hale* 18409 (US). GEORGIA: 5 mi. S. of Quitman, Brooks Co., *Hale* 16775 (US). FLORIDA: 5 mi S. of Tallahassee, Leon Co., *Hale* 16729 (US). ALABAMA: De Soto State Park, Dekalb Co., *Hale* 7047 (US). ARKANSAS: Hollis, Perry Co., *Hale* 3132 (US). COSTA RICA: Faldas del Volcán Irazú, *Valerio* 5 (F). MADAGASCAR: Between Antsirabe and Fianarantsoa, km. 202, *des Abbayes*, Sept. 3, 1956 (US).

7. **Parmelia norstictica** nom. nov. *P. jamaicensis* Vain., Ann. Acad. Sci. Fenn. 6A(7): 23. 1915, non *P. jamaicensis* (Ach.) Spreng., Syst. Veg. 277. 1827 (= *Usnea jamaicensis*). *Parmelia norstictica* is a common lichen on rocks and soil in the West Indies and adjacent Caribbean area. The thallus is membranous, pale straw-colored, with linear-elongate lobes 1-3 mm. wide, more or less isidiate above, black and rhizinate below. The characteristic chemicals are norstictic and usnic acids (medulla K+ red). *Par-*

melia microblasta Vain. (syn. *P. revoluta* fo. *isidiosa* Müll. Arg.) differs only in lacking usnic acid. It is also closely related to *P. abstrusa* Vain., a common species in South America with thicker, more rigid lobes.

Representative specimens examined. JAMAICA: without locality, *F. Børgesen* (C, holotype of *P. jamaicensis* Vain.); southwest slope of Catherines Peak, Blue Mountains, *Imshaug* 13923 (MSC, US). CUBA: Region of La Bayamesa, Oriente, *Morton* 9596 (US). PANAMA: Chiriquí, *Scholander*, February 1941 (US).

8. **Parmelia phlyctina** sp. nov. Thallus adnatus, 5-15 cm. latus, membranaceus, cinereo-candidus, partim in colorem rubrum transeuns in herbario, lobis rotundatis, 5-10 mm. latis, 10-15 mm. longis, 0.08-0.1 mm. crassis, margine nonnihil lobulatus, superne laevigatus vel leviter rugosus, cortice fragile et comminuente, non isidiatus, nec sorediatus, nec ciliatus, medulla alba, inferne niger rhizinosusque in centro, ambitum versus glaber, nitidus, castaneus. Apothecia rara, adnata, 3-8 mm. diametro, disco imperforato, plano; hymenium 25-35 μ altum; sporae octonae, rarus evolutae, 3-5 × 7-8 μ. Pycnidia numerosa, plerumque papillata, conidiis non visis. Thallus K+ flavescens, medulla K+ sanguineus, C−, KC−, P+ aurantiacus, atranorinum et acidum norsticticum continente.

Type in the herbarium of Michigan State University, Blue Mountains, Jamaica, *Imshaug* 14908, Feb. 22, 1953 (*fig.* 2).

Specimens examined. JAMAICA: High Peak, Blue Mountains, *Imshaug* 15248; Sir Johns Peak, Blue Mountains, *Imshaug* 15187 (MSC). CUBA: Region of La Bayamesa, Oriente, *Morton* 9394 (US).

Parmelia phlyctina is almost identical with another endemic Caribbean species, *P. blastica* Vain., except for the lack of isidia. Both are medium-sized species in the Section *Amphigymnia*, adnate, naked below in a rather narrow zone along the margins, and with small spores. The production of norstictic acid is an unusual feature and permits positive identification of either species. The cortex of *P. phlyctina* is extremely fragile and breaks away in small flakes. When specimens are improperly dried, the norstictic acid decomposes and causes a red or pink color in the medulla and cortex.

9. PARMELIA SPHAEROSPORA Nyl., Ann. Sci. Nat. Bot., ser. 4. 11: 254. 1859. *P. leucochlora* Tuck. apud Nyl., Synops. 392. 1860. *P. cubensis* Nyl., Flora 68: 611. 1885. *P. uleana* Müll. Arg., Flora 72: 506. 1889. *P. flavidoglauca* Vain., Acta Soc. Faun. Fl. Fenn. 7: 65. 1890. *P. endoxantha* Merrill, Bryol. 12: 73. 1909. Gyelnik (1935, 1937-38) was the first to discover that

P. endoxantha, *P. flavidoglauca*, and *P. ulcana* are all synonyms of *P. leucochlora*. *Parmelia cubensis* must also be added as a synonym. Recently Dr. H. des Abbayes called to my attention *P. sphaerospora* Nyl., which is the oldest available epithet. An examination of all the type specimens involved has indeed shown that these six entities are identical and that *P. sphaerospora* is the legitimate name. In the United States, *P. sphaerospora* occurs in the coastal plain from South Carolina to Louisiana on sheltered deciduous trees. It seems to be very common in Brazil and southern Africa, somewhat rarer in the West Indies and Central America. The chemistry of the species has not been fully investigated. Most specimens have a pale yellow medulla which may turn more deeply yellow with age in the herbarium. The medulla reacts P−, KC+ orange, and microchemical tests have demonstrated at least barbatic acid. Several specimens from Brazil react P+ light orange, KC−, and contain stictic acid. The yellowish color of the upper cortex is caused by usnic acid in low concentration.

Specimens examined. SOUTH CAROLINA: Beaufort, *Mellichamp* in 1868 (FH). FLORIDA: Orange Park, Clay Co., *Hale* 17738 (US); Sanford, Seminole Co., *Rapp, Krypt. Vind. Exs.* 3654 (US), July 1907 (FH, holotype of *P. endoxantha* Merrill). GEORGIA: 5 mi. SW. of Waycross, Ware Co., *Hale* 16832 (US). ALABAMA: Bon Secour, Baldwin Co., *Evans* 371 (YU). MISSISSIPPI: Ocean Springs, Jackson Co., *Demaree* 38974 (FH, US); without locality, *Veitch* (FH, lectotype of *P. leucochlora* Tuck.). LOUISIANA: Rivière aux Chênes, *Langlois*, Aug. 4, 1886 (US). CUBA: Without locality, *Wright, Lich. Cubae* 76 (H, holotype of *P. cubensis* Nyl.; FH, US, isotypes). BRAZIL: Carassa, Minas Gerais, *Vainio* 1301 (FH, isotype of *P. flavidoglauca* Vain.); Rio de Janeiro, *Ule* 10 (G, holotype of *P. ulcana* Müll. Arg.). HONDURAS: Vicinity of Comayagua, Comayagua, *Standley & Chacón* 5745 (F). MADAGASCAR: *Galinou* (M, isosyntype of *P. sphaerospora* Nyl.).

10. **Parmelia subinvoluta** sp. nov. Thallus orbicularis, usque ad 30 cm. latus, laxe adnatus, rigidiusculus, albidus vel albido-cinerascens, lobis rotundatis, planis, 15-20 mm. latis, 20-30 mm. longis, 0.14-0.20 mm. crassis, superne laevigatus et continuus vel tandem nonnunquam rugulosus, margine sorediatus, sorediis elongatis tenuibusque, 0.3-1.0 mm. latis lobis sorediatis subinvolutis, dense ciliatus, ciliis 3-6 mm. longis, KOH−, medulla alba, subtus niger rhizinosusque in centro, ad ambitum nudus et castaneus vel rarissime albido- et castaneo-variegatus. Apothecia rara. (in *Standley* 4082 solum visa), 5-10 mm. lata, adnata vel subpedicellata, disco imperforato, amphithecio albo-maculata; hymenium 45-55 μ altum; hypothecium 30-35 μ crassum; sporae octonae, 6-7 × 10-

12 μ. Thallus KOH+ lutescens, medulla K—, C—, KC+ roseus, P—, atranorinum et acidum alectoronicum continente.

Type in the U. S. National Herbarium, 4 mi. W. of Midway, Liberty Co., Georgia, *Hale* 16807, April 20, 1958.

Representative specimens examined. NORTH CAROLINA: 8 mi. N. of Burgaw, Pender Co., *Hale* 16307 (US). SOUTH CAROLINA: 12 mi. SW. of Andrews, Georgetown Co., *Hale* 16542 (US). GEORGIA: 5 mi. S. of Quitman, Brooks Co., *Hale* 16778 (US). FLORIDA: Dog Lake Recreation Area, Leon Co., *Hale* 16712 (US); Tomoka State Park, Volusia Co., *Hale* 17082 (US). ALABAMA: Wilmer, Mobile Co., *Hale* 7166 (US). MISSISSIPPI: Near Morton, Scott Co., *Hale* 7910 (US). LOUISIANA: Breaux Bridge, *Langlois*, December 12, 1893 (US). JAMAICA: *Plitt*, July 18, 1932 (BPI). DOMINICAN REPUBLIC: Valdesia Valley, Trujillo, *Allard* 17354 (US). HONDURAS: Vicinity of El Zamorano, Morazán, *Standley* 4082, 11681 (F).

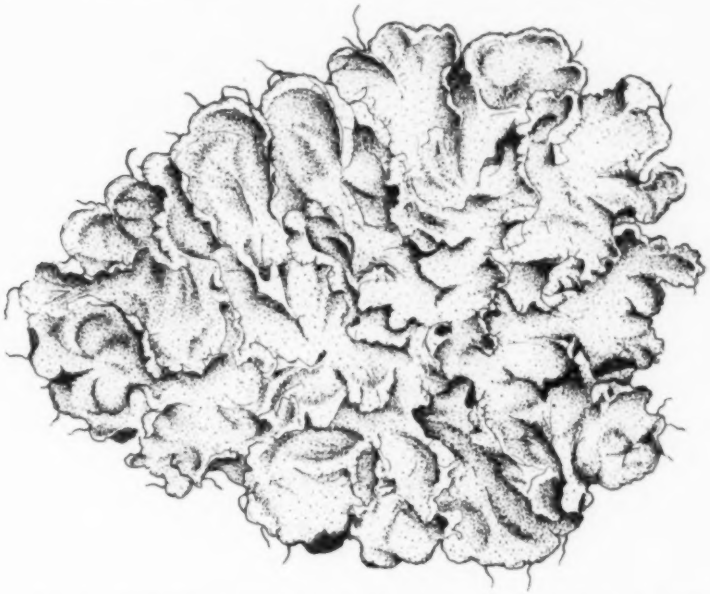

FIG. 4. *Parmelia subinvoluta* (*Langlois*, Dec. 12, 1893), × 1. (Drawing by E. G. Schumacher.)

This conspicuous lichen (*fig.* 4) is very common in the coastal plain of the southern United States from North Carolina to Louisiana, and occurs rarely in the West Indies and Central America also. There are few old herbarium records, most of them labeled *P. cetrata* or *P. perlata* or more recently *P. arnoldii* DuRietz because of the KC+ red reaction. While *P. subinvoluta* has the

same chemicals as *P. arnoldii*, it has marginal soredia in contrast to the laminal and submarginal soredia of *P. arnoldii*. The closest relative is *P. maxima* Hue [syn. *P. claudelii* (Harm.) Vain.], known from temperate North America, Mexico, and Europe, which contains salacinic acid and has plane sorediate lobe tips without noticeable involution, although the lobes on the whole are suberect marginally. *Parmelia subinvoluta* is found on oak trees and even on palm trunks.

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THE HABITAT OF ASCHISMA KANSANUM

ARTHUR A. CRIDLAND[1]

Aschisma kansanum, described by Andrews in 1915, is a cleistocarpous moss belonging to the Pottiaceae. Andrews' description was based on material collected by Hall in western Kansas before 1871. This material (which is in the New York Botanical Garden Herbarium and the Sullivant and James Herbaria at Harvard University) had been previously referred to the European *Aschisma carniolicum*. The exact locality of *A. kansanum* was never recorded, and the plant was not collected again until the fall of 1958. Although Andrews pointed out that *A. kansanum* occurred on siliceous soils containing quartz pebbles, Grout (1938, quoting from a letter of Hall's) described the plant as growing at the base of flint pebbles.

In October 1958 Mr. John E. Morris of the Department of Botany, University of Kansas, collected from the prairie in Barber County, Kansas, a quartz pebble which had *Aschisma kansanum* growing at its base. In November 1958 Mr. Morris and I collected further specimens of *A. kansanum* in the prairies of Reno and Pratt Counties, Kansas, again at the base of quartz pebbles.

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A. kansanum was not common in any of these localities, and considerable time was spent searching for it. The sporophytes of the specimens we collected were not mature. Their stage of development suggests that they mature in spring or early summer. The specimens have all been examined by Dr. Lewis E. Anderson, who agrees with their determination. Dr. A. LeRoy Andrews has seen part of the collection from Barber County and notes that the plants are slightly smaller than those in the type specimen.

Aschisma kansanum occurs at the base of relatively clear quartz pebbles in sandy Pleistocene gravels which (at least in Reno County) belong to the Sanborn and Meade Formations (Bayne, 1956). These gravels are well worn, and all the quartz pebbles

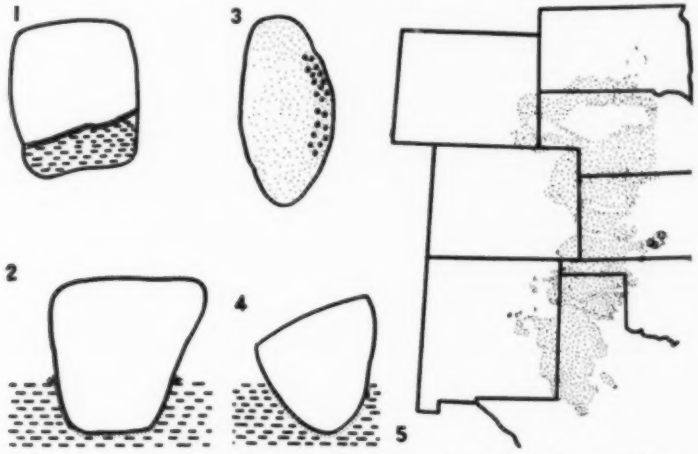

FIG. 1. A quartz pebble from the prairie in Barber County, Kansas. The broken lines represent soil still attached to the pebble, and the thick line at the top of the soil is the zone where gametophytes of *Aschisma kansanum* are produced. *A. A. Cridland* 55, × ⅔. FIG. 2. Theoretical section through the pebble shown in figure 1. The pebble is in the soil (indicated by broken lines), and the persistent protonema of *Aschisma kansanum* (indicated by stippling) clothes it below. Gametophytes are produced at the soil surface. × ⅔. FIG. 3. Plan of a depression in the prairie soil from which a quartz pebble has been removed. The stippling indicates the protonema of a species of *Acaulon* which is producing gametophytes (indicated by large dots) beneath the quartz. *A. A. Cridland* 128, × 1½. FIG. 4. Theoretical section through the depression shown in figure 3 with the quartz pebble still in position. Soil is indicated by broken lines, and the persistent protonema of *Acaulon* is indicated by stippling. A gametophyte produced beneath the quartz is shown on the upper right-hand part of the protonema. × 1½. FIG. 5. Distribution of Pleistocene gravels in the central United States. Localities for *Aschisma kansanum* are indicated by circles.

are smooth. The pebbles with *A. kansanum* growing at their base are from 1 to 5 cm. in diameter. *A. kansanum* has a persistent protonema which clothes the subterranean part of the pebble on which it grows. The gametophytes emerge through the sandy soil at the edge of the pebble (Fig. 1, 2) where they are still relatively well sheltered. Presumably sufficient light passes through the quartz to allow the protonema to carry on photosynthesis. At the same time it is protected from desiccation, which surely limits the growth of prairie mosses and many other plants. The translucency of the quartz is probably quite critical as *A. kansanum* only grows under the most translucent pebbles. Less translucent quartz and opaque pebbles (mainly granite and orthoclase) in the sandy gravel do not have *A. kansanum* growing beneath them. Occasionally some mosses (*Dicranella* sp., *Weissia* sp.) may take advantage of the shelter offered by the north-facing side of opaque pebbles.

The soil in which *A. kansanum* grows is siliceous. In the Barber County locality, it has a pH of 4.5; in the Reno and Pratt County localities it has a pH of 6.5. (The pH was determined electrically). In October and November the prairie is often dry, and the vegetation is rather open (40-50% cover). In summer these prairies are usually dry for long periods, and the vegetation, which grows rapidly with the spring moisture, is much more luxuriant. *Andropogon scoparius* and *Bouteloua gracilis* are the commonest grasses, with *Setaria sp.* and *Cenchrus pauciflorus* also present. *Yucca glauca, Opuntia sp.*, and *Neomamillaria sp.* occur less frequently. The surface of the soil is generally bare between these plants, but in the Reno County locality *Acaulon triquetrum* occurred on the open soil. Similar Pleistocene gravels occur throughout the prairies and plains of the central United States (Fig. 5). *A. kansanum* could possibly be found in these states and in areas where similar gravels of different geological age occur.

Besides *A. kansanum*, other mosses were collected in a similar habitat, but these were far less abundant and less successful. At the Reno County locality a species of *Acaulon* with a persistent protonema was growing beneath a quartz pebble (Fig. 3, 4), and at the Pratt County locality a species of *Weissia*, also with a persistent protonema, was growing beneath a quartz pebble. The gametophytes of both these plants were produced entirely beneath the quartz. They were cholorotic and obviously suffering in the reduced light intensity. Both of these genera do not normally have a persistent protonema. Frequently quartz pebbles were found with protonemata beneath them but no leafy gametophytes. These

protonemata were not identified. Often there were algae beneath the quartz pebbles. I could find no case of another moss utilizing the same habitat with a success comparable to that of *A. kansanum*. This would suggest that there might be some environmental condition besides the amount of moisture beneath the pebble causing *A. kansanum* to grow in its unusual habitat. Perhaps there are favorable localities where *A. kansanum* is not confined to quartz pebbles, but these have not yet been found. Further collections will indicate which view is correct, and additional collections of *A. kansanum*, especially of material with sporophytes, will be useful in reviewing the taxonomic position of this plant. Both Andrews (1915) and Hilpert (1933) point out that *Aschisma kansanum* and the European species of *Aschisma* may not be congeneric.

Specimens of *Aschisma kansanum:* Barber Co., Kansas, prairie 2.9 mi. south of Sawyer, Sect. 12, T. 30 S., R. 13 W., 11 Oct. 1958, *A. A. Cridland* 55. Pratt Co., Kansas, prairie 4 mi. west of Coats, 22 Nov. 1958, *A. A. Cridland* 133. Reno County, Kansas, prairie 2 mi. north of Arlington and in a north-facing gully by a farm pond, west of State Highway No. 14, S.E. ¼, Sect. 27, T. 24 S., R. 8 W., 22 Nov. 1958, *A. A. Cridland* 134, 135.

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FRULLANIA LAXIFLORA[1]

Lois Clark[2]

Frullania laxiflora Spruce, Trans. Bot. Soc. Edinburgh 15: 26. 1884. Plants large, graceful, creeping close to substratum, flaccid, dark brown, reddish or yellow-green. Leafy stem to about 8 cm. long and 1.75 mm. wide, regularly pinnate; primary branches to 3 cm. long, these again sparsely yet regularly and shortly pinnulate; branches 6-7 leaves apart on same side of stem. Stem

[1] This work was made possible by a grant from the Biological and Medical Research Fund of the State of Washington.

[2] Dept. of Botany, University of Washington, Seattle, Wash.

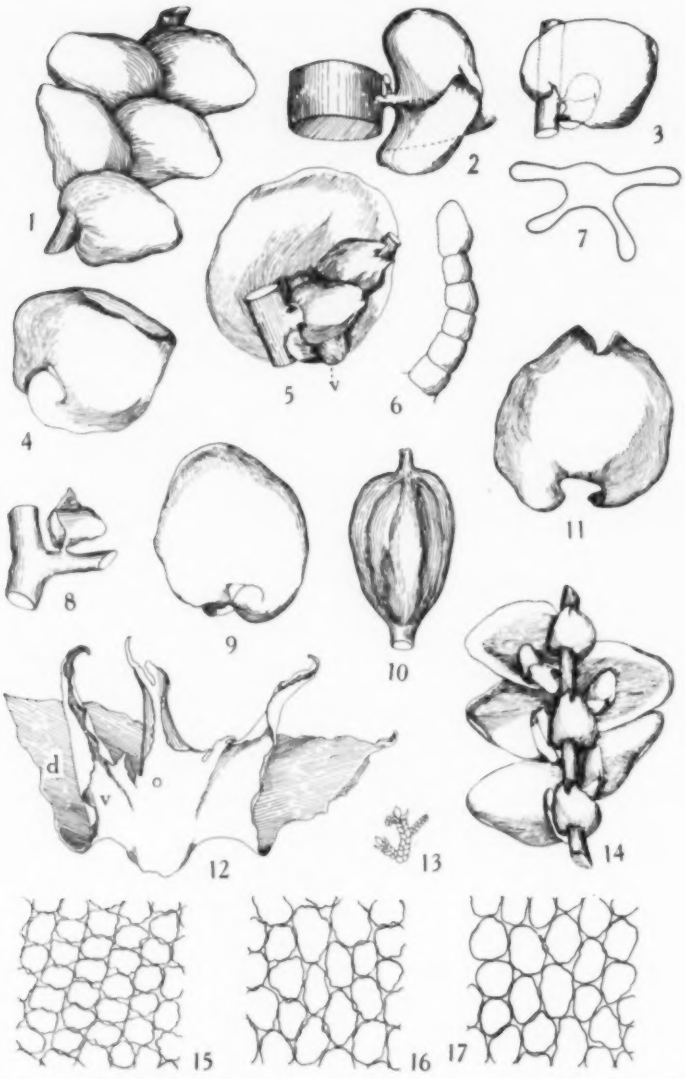

FIG. 1-17, *Frullania laxiflora*. 1. Part of plant, dorsal view, × 18. 2. Ventral lobe of stem leaf, × 50. 3. Leaf, dorsal view, × 23. 4. Leaf subtending branch, ventral lobe omitted, × 29. 5. Leaf subtending branch, its ventral lobe (*v*), and the first underleaf, × 29. 6. Stylus, × 289. 7. Cross-section of perianth, × 24. 8. First leaf of branch, × 29. 9. Stem

light brown to dark brown, to 177 μ in diameter; in cross-section cells about same size throughout, cortex of one layer of cells; walls yellowish, thick; central area of thick-walled colorless cells. Leaves contiguous or imbricate, obliquely spreading; unequally bilobed. Dorsal lobe subrotund or ovate, concave, 0.63-1.2 mm. (measured from insertion) by 0.35-1.25 mm., asymmetric, apical portion somewhat narrower than basal; apex obtuse to rounded; margin entire; dorsal margin crossing the stem to half a stem-width beyond; base auriculate; auricles long, folded over each other when leaf is pulled off. Ventral lobe quite close to stem and parallel with it, twice as long as wide, 630-890 by 319-440 μ, grading to cucullate explanate ones; upper part when galeate with suggestion of proboscis, narrower above; mouth various, often obliquely truncate; lower part explanate, often oblong to sub-orbicular, often broader than saccate portion, margin sinuate. Stylus a single row of 4-6 cells. Leaf subtending a branch larger than stem leaves, symmetric, 0.994-1.278 mm. long and 0.994-0.278 mm. wide, longer than wide to wider than long; apex decurved, obtuse to emarginate, margins entire; base auriculate, auricles overlapping when leaf is removed; ventral lobe present, saccate. First leaf of branch similar to, but smaller than stem leaves. Cells of stem leaves in apical and marginal regions equilateral, averaging 17 μ; walls thin, flexuous, intermediate thickenings abundant; median cells 20-26 by 17 μ; trigones rather small, walls thick; basal cells 34 by 17 μ, walls thick but less flexuous; trigones somewhat enlarged throughout leaf; intermediate thickenings fewer in basal region. Underleaves very large, 3 times as wide as stem, averaging 1/2 to same in area as stem leaves, ovate to orbicular or wider than long, 710-735 μ long and 781-852 μ wide, 1/6-1/4 bilobed; sinus obtuse, broadly triangular, more or less connivent, lobes acute; margins entire, narrowly recurved; base auriculate; auricles free, canaliculate. First underleaf of a branch broadly triangular-ovate, acuminate to retuse. Plants bisexual. Male inflorescence on short lateral branch, capitate, first underleaf of male branch unequally bilobed; male bracts 4 pairs, bracts subequally bilobed, margins entire except for small tooth (stylus) on the inner edge of ventral lobe, apex rounded; male bracteoles oblong, becoming smaller toward tip of inflorescence, unequally bilobed. Female inflorescence on short lateral branch, rarely on long branch.

leaf, dorsal view, × 24. 10. Perianth, × 14. 11. Underleaf of stem, × 29. 12. Involucre, ventral lobe (*v*) of bract (*b*), and female bracteole (*o*), × 24. 13. Part of plant, × 1. 14. Part of branch, ventral view, × 18. 15. Cells near apex of dorsal leaf lobe, × 228. 16. Cells near middle, × 228. 17. Cells near base, × 228. (*All drawings from type, by Janet Fukuda.*)

Involucre with a very similar whorl beneath and widely separated from it. Bracts of upper whorl larger than stem leaves, widely spreading, unequally bilobed. Dorsal lobe ovate-oblong, 1-1.4 mm. long and 660-800 μ wide, gradually acute to acuminate, margins entire to sinuate. Ventral lobe as long as dorsal lobe, united with it for 1/3 their lengths, ovate-lanceolate, 1-1.5 mm. long and 284-426 μ wide, acuminate, strongly canaliculate; inner (adaxial) base with one large tooth or lacinia (stylus), otherwise margins entire or merely sinuate. Bracteole united at base for 1/3 its length with both bracts, narrowly oblong, 885 by 375 μ, 1/4-1/2 bifid; lobes narrowly laciniate to subulate, canaliculate; margins entire or rarely with one or more laciniae on each side near base. Perianth up to 1/4 emergent, oval or obovate-fusiform, 1.6-1.8 mm. long and 0.9-1.13 mm. wide, 4-plicate, narrowed or rounded to beak; beak about twice as long as wide, 106-142 by 71-78 μ. Sporangium borne on short seta which is arched laterally from the perianth, globose; elaters red-brown, unispiral, 213-248 μ long, 14 μ wide; spores large, 42-51 μ in diameter.

HABITAT: On trees.

TYPE LOCALITY: Ecuador, Andes Quitenses, Guataxi, alt. 2200 m., *Richard Spruce*, 9379, in 1858.

SPECIMENS EXAMINED: Peru: San Miguel bas, *H. Ward Goote*, in 1911. Ecuador: TYPE.

RANGE: Guatemala, Venezuela, Ecuador, and Peru.

Frullania laxiflora is easily separated from *F. arecae* and *F. riojancirensis* when the perianth is present, since it has two involucral whorls, the inner or true involucre distinctly distant from the outer, and the perianth is scarcely emergent. Spruce described the capsules as being on a short seta arching from the perianth laterally. What we have seen is the same, but the material is too old and the perianths too few for us to state that this character can be relied upon as a specific distinction.

RANGE EXTENSIONS OF BRYOPHYTES IN EASTERN UNITED STATES

F. J. HERMANN[1]

Collections made by the writer in 1957 and 1958 in New York, Maryland, and Virginia include species which evidently have not been reported previously from those states or which otherwise

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represent significant extensions of range and seem to merit putting on record. Grateful acknowledgement is made to H. A. Crum and H. S. Conard for determination or verification of the majority of these collections, and thanks are also due to L. E. Anderson, A. L. Andrews, and Winona Welch for aid in special groups.

Species preceded by an asterisk are, so far as could be determined, new to the states from which reported. Location of specimens is indicated by the following abbreviations: A—New York State Museum, Albany; Can—National Herbarium of Canada; Cin—University of Cincinnati; Dk—Duke University; H—Herbarium of F. J. Hermann; Hol—Hollins College, Va.; NY—New York Botanical Garden; SNP—Shenandoah National Park, Luray, Va.; US—U.S. National Herbarium.

Adirondack Mountain Area, Northern New York

Until recently Burnham's lists of mosses and hepatics of the Lake George area (1919-20) were the only guides to the bryophytes to be expected in this region. But the publication in 1958 of a comprehensive "Check List of the Mosses of New York State" by E. H. Ketchledge greatly facilitates the detection of range extensions within the state as a whole. In this useful work the state is divided into 26 numbered geographic districts (based on square degrees of latitude and longitude), and the known distribution of each species is indicated by a chart showing its occurrence in or absence from each district. In the present report rare or infrequent taxa are considered first, and species of more general distribution, but herein recorded from new districts, are then listed for the purpose of augmenting the distribution record. Numbers in square brackets following the collection number and abbreviations of herbaria represent the district from which the species is now reported.

Buttermilk Falls, which is the station for several of the reports, is located on the Raquette River, alt. 1700 ft., 5 mi. SW. of the village of Long Lake, Hamilton County.

**Tritomaria quinquedentata* (Huds.) Buch. Peaty soil on boulder in heath, exposed granite summit of Whiteface Mt., alt. 4870 ft., 4½ mi. WSW. of Wilmington, Essex Co., Aug. 9, 1958 (14758, A;Cin;H;NY;US) [4]. This collection represents the infrequent gemmiparous phase. Not recorded from New York by Frye and Clark. R. M. Schuster, who identified the collection, informs me that he has collected the species in the Adirondacks, and his distribution map in *The American Midland Naturalist* 59: 304 (1958) shows a dot in the Adirondack area. It has also been collected in the Catskills by Stanley J. Smith according to information received from him (gorge below Kaaterskill Falls, Greene County, *S. J. Smith* & *J. A. Wilcox* 11519, A).

Blindia acuta (Hedw.) BSG. Small mats on wet boulder in spray from Buttermilk Falls, Aug. 22, 1957 (13981, A;Can;H) and July 28, 1958 (14475, Can;Dk;H;NY;US) [10]. Recorded only from districts 3, 4 and 17 by Ketchledge.

**Campylium chrysophyllum* var. *brevifolium* (R. & C.) Grout. Moss-covered gneiss boulder in birch-fir woods beside Buttermilk Falls, July 28, 1958 (14486, A;Can;H) [10]. The rather well-marked variety with strongly

falcate leaves, simulating *Drepanocladus*, is generally more southern in its distribution. It is not recorded from New York, although the typical form is widespread in the eastern half of the state.

Grimmia agassizii (Sull. & Lesq.) Lesq. & James. Small cushions on boulder in Au Sable River, alt. 2000 ft., at crossing of Heart Lake Rd., 3½ mi. S. of North Elba, Essex Co., Aug. 21, 1957 (13928, A;Can;Dk;H; NY;US) and Aug. 9, 1958 (14769, Dk;H) [4]; boulder in Bouquet River, 5 mi. S.E. of St. Huberts, Essex Co., Aug. 11, 1958 (14807, A;Can;Dk;H; NY;US) [4]; in crack in boulder drenched by mist from Buttermilk Falls, July 28, 1958 (14477, A;Can;H;US) [10]; and, wet rocks at water level, Buttermilk Falls (14498, Can;NY) [10]. Reported only from district 11.

Grimmia apocarpa var. *dupretii* (Thér.) Sayre. Granite outcrop at edge of woods along highway, 1 mi. E. of Sabattis, Hamilton Co., Aug. 2, 1958 (14619, A;Can;H;US) [3]. Previously known only from district 17 (Catskill Mts.).

Grimmia unicolor Hook. Small cushions on boulder drenched by mist from Buttermilk Falls, July 28, 1958 (14479, A;Can;Dk;H;NY;US) [10]. Previously reported only from district 17 (Catskill Mts.).

Hygrohypnum montanum (Wils.) Broth. On boulder in streamlet in dark hemlock-fir woods, alt. 1700 ft., 2 mi. SW. of Long Lake (village), Hamilton Co., Aug. 8, 1958 (14723, A;Can;H;US) [10]. Previously reported from districts 3, 4 and 17.

*Oncophorus tenellus (BSG) Williams. Peaty soil on boulder in heath, exposed granite summit of Whiteface Mt., alt. 4870 ft., 4½ mi. WSW. of Wilmington, Essex Co., Aug. 9, 1958 (14761, A;Can;Dk;H;NY;US) [4]. Grout's *Moss Flora* gives the distribution of the species as "Labrador to Alaska, south to the mountains of New England, Minnesota and Montana."

**Philonotis fontana* var. *falcata* Brid. Extensive cushions on dripping rock outcrop on steep bank of highway (NY 73), 5 mi. SE. of St. Huberts, Essex Co., Aug. 11, 1958 (14804, A;Can;H;NY;US) [4]. The falcate-secund leaves and branches hooked towards the apex give the plants an aspect quite distinctive from the typical form.

**Pohlia annotina* var. *decipiens* Loeske. Crevice in gneiss outcrop along highway (NY 365), alt. 1700 ft., 6½ mi. E. of Tupper Lake (village), Franklin Co., Aug. 9, 1958 (14732, A;Can;Dk;H;NY;US) [3]. The variety, characterized by elongated, twisted-vermiform gemmae and often confused with *P. proligera*, according to Andrews in Grout's *Moss Flora*, is not reported in Ketchledge's *Checklist*. The collections of typical *P. annotina* there reported are, with the exception of district 11, all in the southern half of the state. The assemblage of rare Pohlias at this Franklin County station seems remarkable, the following two species new to the state occurring at the same locality.

**Pohlia bulbifera* (Warnst.) Warnst. With the preceding, Aug. 21, 1957 (13896, A;Can;Dk;NY;US) [3]. Only three North American localities for the species are cited by Andrews in Grout; these are in Nova Scotia, New Hampshire and Massachusetts.

**Pohlia rothii* (Corr.) Broth. With the preceding but occurring very sparsely on thin layer of rich oil on crest of outcrop among *Atrichum undulatum* (13898½, Can;NY) [3]. The only definite American localities are in New Hampshire, Massachusetts and Alaska.

**Rhacomitrium canescens* Brid. Damp soil in pockets in gneiss outcrop along Raquette River at Buttermilk Falls, July 28, 1958 (14469, A;Can; Dk;H;NY, and 14470, Can;Dk;US) [10]. Both collections represent the forma *ericoides* (Brid.) Moenk., characterized by numerous short lateral

branches and hyaline-tipped leaves. In 14469 the hyaline apices are short, but in 14470 they are long and awn-like. Jones in Grout's *Moss Flora* gives the distribution of fo. *ericoides* as Alaska to Oregon and Montana; Nova Scotia; Greenland; Europe; Japan.

Rhacomitrium heterostichum var. *affine* (Schleich.) C. Jens. Loose mats on vertical face of boulder near water level in stream in yellow birch-sugar maple woods, alt. 1700 ft., *2* mi. SW. of Long Lake (village), Aug. *23*, 1957 (14006, A;H;US); tight, straggling mats on flat rock along trail in woods, alt. ca. *2300* ft., west slope of Blue Mt., Hamilton Co., Aug. *24*, 1957 (14030, A;Can;H;US); thin, tight mat on shaded outcrop at edge of woods, The Pinnacle, alt. *2165* ft., 1 mi. NE. of Long Lake (village), Aug. 1, 1958 (14593, A;Can;H;US) [10]. All collections represent the fo. *obtusum* (Sm.) Moenk., which is frequently confused with *R. fasciculare* (Hedw.) Brid. Variety *affine* is reported in the "Check List" only from district 4.

Sematophyllum marylandicum (C. M.) Britt. Matting boulder in streamlet in dark hemlock-fir woods, alt. 1700 ft., *2* mi. SW. of Long Lake (village), Hamilton Co., Aug. 7, 1958 (14720, A;Can;Dk;H;NY;US) [10]. Reported only from district 20, in southern New York.

ADDITIONAL DISTRICTS FOR NEW YORK STATE:

Amphidium lapponicum (Hedw.)-Schimp. (13997, A;Can;H) [10].

Anomodon rostratus (Hedw.) Schimp. (14649, A;NY;US) [3].

Barbula unguiculata Hedw. (14620, A;US) [3].

Brachythecium oxycladon var. *dentatum* (Lesq. & James) Grout (13909, A;H;US) [3].

Bryum cuspidatum (BSG.) Schimp. (13881, A;H;US; 14622, A;Dk;H;US) [3].

Campylium polygamum (BSG.) Bryhn (14650, A;Can;Dk;H;US) [3].

Dicranum bonjeanii DeNot. (13868½, H;US, admixture with *Plagiothecium striatellum*) [3].

Ditrichum lineare (Sw.) Lindb. (13893, A;H;US; 14729, NY) [3].

Fissidens minutulus Sull. (14736, Dk;NY;US; 14737, Can;H) [4].

Fontinalis novae-angliae Sull. (13927, A;H;NY) [4]; (14013, A;H;US) [3].

Grimmia apocarpa var. *alpicola* (Hedw.) Hart. (14476½, A;Can;Dk;H;US) [10].

Grimmia apocarpa var. *stricta* (Turn.) Mitt. (14002, A;Can;H;US) [10]; (14621, H;US) [3].

Heterophyllium haldanianum (Grev.) Kindb. (13814½, A;H;US, admixture with *Hypnum reptile*) [21].

Hygroamblystegium tenax (Hedw.) Jenn. (14739, A;Can;NY;US) [4].

Hypnum reptile Mx. (13814, A;Can;H;US) [21.]

Orthotrichum elegans Hook. & Grev. (14611½, A;Can;H;US) [10].

Orthotrichum pumilum Dicks. (13829, A;H;US) [10].

Philonotis muhlenbergii (Schw.) Brid. (14439, A;Can;H;US) [17].

Plagiothecium denticulatum var. *tenellum* BSG. (14568, A;Dk;NY; 14606, A;H;US) [10].

Plagiothecium roeseanum (Hampe) BSG. (13912, A;Dk;H;US) [3].

Rhacomitrium heterostichum var. *sudeticum* (Funck) Jones (13959, A;H;NY;US) [10].

Sphagnum centrale C. Jens. (13875, A;Dk;H;US) [3]

Sphagnum teres (Schimp.) Angstr. (13876, A;H) [3].

MARYLAND

Because of the lack of published floristic studies of the bryophytes either of Maryland as a whole or of areas within the state, it is often difficult to ascertain whether a record is new. Reliance has had to be placed, therefore, on monographs giving citations of specimens, upon Grout's *Moss Flora of North America*, and upon the presence or absence of Maryland specimens in the U. S. National Herbarium which seems to be the most likely repository for collections from this area.

**Fossombronia brasiliensis* Steph. Open clay bank of pond in pine woods near Entomology Research Division, U.S.D.A. Research Center, 2½ mi. NE. of Beltsville, Prince Georges Co., Oct. 13, 1957 (14128, Can;Cin;H;NY; US). The nearest record for this species in Frye and Clark is New Jersey.

**Fossombronia cristula* Aust. With *Riccia sullivantii* and *Nanomitrium megalosporum* on wet, open clay flat bordering Snowdon Pond, Patuxent Wildlife Refuge, 4 mi. SE. of Laurel, Prince Georges Co., Oct. 12, 1957 (14125, Can;Cin;H;NY;US). New Jersey (Batsto, type locality) is the nearest record for this hepatic (for the most part more southern in range) in Frye and Clark and also among the material in the U. S. National Herbarium.

**Amphidium mougeotii* (BSG.) Schimp. Damp sandstone bluff in deep shade below Muddy Creek Falls, alt. 2300 ft., Swallow Falls State Forest, 8 mi. NNW. of Oakland, Garrett Co., Aug. 30, 1958 (14920½, H;US).

**Brotherella delicatula* (James) Fl. Dense, extensive mats on bark of oak log in open woods along Ammendale Rd., 1¼ mi. NW. of Beltsville, Prince Georges Co., Aug. 11, 1957 (13803, Dk; H;NY;US).

**Brotherella tenuirostris* (Schimp.) Broth. Thin soil on rock outcrop in woods, and base of chestnut oak on dry, rocky slope along Fishing Creek, alt. ca. 1000 ft., Catoctin Mt., 2½ mi. NW. of Bethel, Frederick Co., May 2, 1958 (14273, Dk;H;NY;US; 14275, Dk;H;US; 14276, Dk;H;US 14284, Dk; H US); extensive, thin tight mat on bark of black oak stump in oak-tuliptree woods along Paint Branch east of Powder Mill Rd., 2½ miles W. of Beltsville, Prince Georges Co., May 10, 1958 (14295, Can;Dk;H;NY; US). Dr. L. E. Anderson, who determined the Catoctin Mt. collections, expressed surprise that this species, ordinarily found at much higher altitudes in the Appalachians, should occur in such abundance there. Even more unexpected, therefore, was its discovery in Prince Georges County at little above sea level on the Atlantic Coastal Plain.

**Clasmatodon parvulus* (Hampe) Sull. On black walnut trunk, shore of Wicomico River at Camp St. Charles, Rock Point, Charles Co., June 29, 1958 (14365, Can;Dk;H;NY;US). Cited by Grout, in his *Moss Flora*, only from as far north as Virginia.

Homalotheciella subcapillata (Hedw.) Card. On trunk of white oak in woods along Severn Run, 3½ mi. NNE. of Gambrills, Anne Arundel Co., June 7, 1958 (14338, Can;Dk;H;NY;US). The only other Maryland collection in the U. S. National Herbarium is one from Baltimore Co. made by J. D. Smith in 1876.

**Nanomitrium megalosporum* (Aust.) Lindb. Among dead sedges and grasses on wet clay flat bordering Snowdon Pond, Patuxent Wildlife Refuge, 4 mi. SE. of Laurel, Prince Georges Co., Oct. 12, 1957 (14124, Can; Dk;H;NY;US). Not mentioned from Maryland in Bryan and Anderson's recent study of the Ephemeraceae (1957).

**Pleuridium palustre* (Bruch & Schimp.) BSG. Data as for preceding species, April 17, 1958 (14229, Can;Dk;H;NY;US). Grout's *Moss Flora* gives the distribution in America as "Massachusetts to Tennessee; rare."

**Tortula papillosa Wils.* Top of low stone wall on slope of Sugarloaf Mt., 2 mi. W. of Thurston, Frederick Co., Oct. 11, 1958 (14987½, Can;Dk; H;NY;US). Not cited from Maryland in Schnooberger's study of the species (1942).

Trichostomum cylindricum (Bruch) C. M. Wet ledge of shaded cliff beside Muddy Creek Falls, alt. 2300 ft., Swallow Falls State Forest, 8 mi. NNW. of Oakland, Garrett Co., Aug. 30, 1958 (14910, Can;Dk;H;NY; US). The single previous Maryland collection in the U. S. National Herbarium, made by J. D. Smith in 1876, is also from Garrett Co. but is without other locality data.

Virginia

The excellent series of papers on bryophytes of Virginia by Patterson (1949-55) has kept our knowledge of their distribution gratifyingly up to date for this state.

**Aphanorrhegma patens* (Hedw.) Lindb. Hard clay bank of Potomac River, White's Ferry, Loudoun Co., Aug. 22, 1958 (14818, Can;Dk;H;Hol; NY;US). Mixed with *A. serratum*.

Barbula cruegeri Sond. ex C. M. Shallow sand pockets in flat calcareous rock in Cedar Creek, Natural Bridge, Rockbridge Co., Oct. 18, 1958 (15089, Can;Dk;H;Hol;NY;US). The only previous Virginia report is from Isle of Wight Co. (Patterson, 1950).

Oreoweisia serrulata (Funck) DeNot. Crevice in steep gneiss bluff on bank of Potomac River at Great Falls, Fairfax Co., June 12, 1958 (14343, Can;Dk;H;Hol;NY;US). The discovery of this species, normally of cool and elevated regions, on the Fall Line at an elevation of only 150 ft. was decidedly unexpected. The other Virginia records are from Giles, Lee and Roanoke counties (Patterson, 1949, 1950).

**Orthotrichum anomalum* Hedw. Very sparse on gneiss boulder on bank of Potomac River at Great Falls, Fairfax Co., June 12, 1958 (14344, Can; Hol; 14345, Can;US).

Shenandoah National Park, Virginia

An annotated list for this area of the Blue Ridge Mts. by Schnooberger and Wynne (1945) has been supplemented by papers by Patterson (1955) and Prior (1959). Three of the writer's collections (*Anacamptodon splachnoides, Fabronia ciliaris* and *Rhacomitrium aciculare*) were included in the last of these.

**Brachythecium campestre* BSG. Base of white oak in hemlock woods, alt. 3450 ft., Whiteoak Canyon Trail, Madison Co., Sept. 14, 1958 (14960, Can;Dk;H;Hol;NY;SNP;US). Grout, in his *Moss Flora*, says, "As yet no specimens have been reported from farther south than New Jersey."

Campylium chrysophyllum var. *brevifolium* (R. & C.) Grout. On wet rock at edge of Dark Hollow Falls, alt. 3000 ft., Madison Co., July 3, 1958 (14392, Can;Dk;H;Hol;SNP;US); dripping schist bluff, and rock outcrop in deep shade, in woods along stream below First Falls, Whiteoak Canyon, alt. 2500 ft., Madison Co., Aug. 22, 1958 (14819, Can;Dk;H;NY; 14831½, SNP;US).

Fontinalis dalecarlica BSG. Rock bottom of swift stream in woods, Whiteoak Canyon, alt. 2600 ft., Madison Co., Sept. 15, 1958 (14971, Dk;H; Hol;SNP;US).

Hypnum pratense Koch. Under *Sanguisorba* in open swamp near Big Meadows Campground, alt. 3400 ft., Madison Co., Aug. 23, 1958 (14859, Can;H;Hol;SNP;US).

Philonotis longiseta (Mx.) Britt. Crevices in bluff near stream below Third Falls, Whiteoak Canyon, alt. 2100 ft., Aug. *22*, 1958 (14842, Can;H; Hol;SNP;US). This appears to be the second known collection from Virginia with definite locality, the previous report being from Prince George Co. (Patterson, 1951).

Sphagnum imbricatum Hornsch. Under *Sanguisorba* in open swamp near Big Meadows Campground, alt. 3400 ft., Madison Co., Aug. 23, 1958 (14861, Dk;H;Hol;SNP;US). Dr. Andrews refers this collection to var. *affine* (R. & C.) Warnst. Only one other *Sphagnum* (*S. subsecundum*) is known from the Park (Prior, 1959).

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ADDITIONS TO THE HEPATICAE OF ONTARIO

H. Williams[1] and R. F. Cain[2]

During the 11 years which have elapsed since the publication of the previous list of the Hepaticae of Ontario by Cain and Fulford (1948), additional collections have been made in various parts of the province. As a result of this study, 36 species have been added. These are preceded by an asterisk in the following list, which includes additional distribution records for 39 of the more significant species included in the earlier publication.

We are very much indebted to Dr. R. M. Schuster for his continued assistance in the identification of many of the collections.

Anastrophyllum michauxii (Web.) Buch. Algoma; Algonquin Park; Manitoulin Is.; Thunder Bay.

Anthoceros laevis L. Collected again in 1955 at Grenadier Pond, High Park, York.

*Anthoceros macounii Howe. Glen Williams, Halton, with *Notothylas orbicularis* and *A. punctatus*.

*Anthoceros punctatus L. Glen Williams, Halton. Plants with the dorsal surface crispate, ranging from 2-13 mm., averaging 7-8 mm., growing under moist conditions. To be referred to this species, according to Proskauer (1948).

*Asterella ludwigii (Schw.) Underw. Mt. McKay, Thunder Bay, *C. E. Garton*, 1955, det. Schuster. Reported by Crum (1956).

Barbilophozia hatcheri (Evans) Loeske. On mineral soil, Madawaska River, below Cache Lake, Algonquin Park; Lake Timagami.

*Calypogeia fissa (L.) Raddi. High Park, York; Byng Inlet, Parry Sound.

Calypogeia meylanii Buch. Fairly common in cold swamps. Durham; Halton; York.

*Calypogeia muelleriana (Schiffn.) K. M. Manitoulin Is.; Ontario.

*Calypogeia suecica (Arn. & Perss.) K. M. Durham; Halton.

Calypogeia sphagnicola (Arn. & Perss.) Warnst. & Loeske. W. of Raith, Thunder Bay.

*Cephaloziella elachista (Jack) Schiffn. Manitoulin Is., det. Schuster; Durham; Lake Timagami.

*Cephaloziella rubella (Nees) Douin. Durham; Manitoulin Is.; York.

*Chandonanthus setiformis (Ehrh.) Mitt. [= *TEMNOMA setiforme* (Ehrh.) Howe]. Ouimet Canyon, 10 mi. N. of Dorion Station, Thunder Bay, *C. E. Garton*, det. H. Crum.

Cololejeunea biddlecomiae (Aust.) Evans. Common and widely distributed in cedar swamps and on rock. Dufferin; Durham; Halton; Hastings; Lennox and Addington; Peel; Peterborough; Simcoe; Thunder Bay; Wellington; Wentworth; York.

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*DIPLOPHYLLUM APICULATUM var. OBTUSATUM Schust. Algonquin Park. Atypical in lack of gemmae and in pure green color.

FOSSOMBRONIA DUMORTIERI (Hüb. & Genth.) Lindb. (*F. foveolata* Lindb.). Algoma; Hastings; Parry Sound; Peterborough.

*FOSSOMBRONIA WONDRACZEKII (Corda) Dum. Hatchley, Brant.

FRULLANIA ASAGRAYANA Mont. On rock cliffs. Algoma; N. of Maynooth, Hastings; N. shore of Lake Superior, Thunder Bay.

*FRULLANIA SELWYNIANA Pears. On rock cliff. Outlet from Cache Lake, Algonquin Park.

GYMNOCOLEA INFLATA (Huds.) Dum. Algoma; L. Timagami; High Park, Toronto, York.

ISOPACHES BICRENATUS (Schmid.) Buch. Algoma; Algonquin Park; Durham; Muskoka; Peterborough; Nipissing.

JUNGERMANNIA LANCEOLATA L. Algoma; Dufferin; Durham; Halton; Hastings; Manitoulin Is.; Parry Sound; Wellington; York.

*LEIOCOLEA BADENSIS (Gottsche) Joerg. Algoma; Dufferin, det. Evans; Grey.

LEIOCOLEA HETEROCOLPOS (Thed.) Buch. Algoma; Algonquin Park; Cochrane; Manitoulin Is.; Thunder Bay.

LEJEUNEA CAVIFOLIA (Ehrh.) Lindb. Algonquin Park; Dufferin; Durham; Halton; Hastings; Nipissing; Peel; Peterborough; Simcoe; L. Timagami; York.

LOPHOCOLEA MINOR Nees. Durham; Dufferin; Halton; Hastings; Peel; Manitoulin Is.; Parry Sound; Peterborough; Thunder Bay; York.

LOPHOZIA ALPESTRIS (Schleich.) Evans. Algoma; Algonquin Park; L. Timagami.

*LOPHOZIA ASCENDENS (Warnst.) Schuster. Algoma; L. Opeongo, Algonquin Park; Durham; L. Timagami, det. Schuster.

*LOPHOZIA CAPITATA (Hook.) K. M. Algonquin Park; Manitoulin Is. (Schuster, 1953, p. 346, pl. 10.); Muskoka.

LOPHOZIA EXCISA (Dicks.) Dum. Algonquin Park; Halton; Hastings; Manitoulin Is.; Muskoka; Nipissing; Peterborough.

LOPHOZIA INCISA (Schrad.) Dum. Algonquin Park; Durham; Halton; Hastings; Kenora; Manitoulin Is.; Thunder Bay; Wellington.

*LOPHOZIA LONGIDENS (Lindb.) Macoun. Algoma; Algonquin Park; Hastings; Kenora; Manitoulin Is.; Muskoka; Peterborough; Thunder Bay.

LOPHOZIA MARCHICA (Nees) Steph. Algoma; Durham.

*LOPHOZIA SILVICOLA Buch. Algonquin Park; Kenora; Manitoulin Is.; Muskoka; Thunder Bay.

*LOPHOZIA WENZELII (Nees) Steph. L. Timagami; 8 mi. S. of Sudbury, Sudbury.

*MANNIA FRAGRANS (Balb.) Frye & Clark [= *Grimaldia fragrans* (Balb.) Corda]. Gravelly hills of the interlobate moraine, Millbrook, Durham.

*MANNIA SIBIRICA (K. M.) Frye & Clark (= *Grimaldia sibirica* K. M.). Kenora; Mt. McKay, Thunder Bay, 1955, *C. E. Garton*, det. Schuster. Reported by Crum (1956).

MARSUPELLA EMARGINATA (Ehrh.) Dum. Algoma; East R., Nipissing.

*MARSUPELLA PAROICA Schust. (1957). Algonquin Park.

MARSUPELLA SPHACELATA (Gies.) Lindb. On rock cliff, Katrine Lake, Sudbury; on wet rock in streamlet, Pinetree Lake, Algonquin Park.

*METZGERIA FURCATA var. ULVULA Nees. Peterborough.

METZGERIA CONJUGATA Lindb. Additional collection from Bancroft, N. Hastings.

*Microlepidozia setacea (Web.) Joerg. Pancake Bay, Algoma; Manitoulin Is.

Moerckia hibernica (Hook.) Gottsche. Durham; Halton.

Mylia anomala (Hook.) S. F. Gray. Algoma; Durham; Manitoulin Is.; Ontario.

*Mylia taylori (Hook.) S. F. Gray. Algoma.

*Notothylas orbicularis (Schwein.) Sull. Hatchley, Brant; Halton; Peel.

Odontoschisma denudatum (Mart.) Dum. Algoma; Algonquin Park; Durham; Halton; Kenora; Parry Sound; Thunder Bay.

Pallavicinia lyellii (Hook.) S. F. Gray. White's Woods, Elgin Co.; Bat L., Algonquin Park.

*Pellia neesiana (Gottsche) Limpr. On humus on log, bank of stream, Eel's Creek Park, Peterborough; Egan Chute, Bancroft, Hastings.

Porella pinnata L. On calcareous rocks in streambed, Rattlesnake Point, Halton.

Reboulia hemisphaerica (L.) Raddi. Algonquin Park; Blue L., Brant; Durham; Niagara Gorge, Welland.

Riccardia multifida (L.) S. F. Gray. Algoma; Algonquin Park; Dufferin; Durham; Halton; Ontario; Wellington.

Riccardia palmata (Hedw.) Carruth. Kenora; Parry Sound.

Riccardia pinguis (L.) S. F. Gray. Algoma; Algonquin Park; Dufferin; Durham; Halton; Thunder Bay.

*Riccia crystallina L. Halton; Simcoe; York.

Scapania apiculata Spruce. Durham.

*Scapania cuspiduligera (Nees) K. M. Shore of L. Superior at Heron Bay, Thunder Bay.

*Scapania glaucocephala (Tayl.) Aust. Durham; Halton; Kenora.

*Scapania gymnostomophila Kaal. Algoma; Bruce; N. Hastings; L. Superior shore at Heron Bay, Kakabeka Falls, Thunder Bay.

Scapania irrigua (Nees) Dum. Algonquin Park; Halton; Nipissing; Ontario; Peterborough.

*Scapania mucronata Buch. Algonquin Park; Durham; Hastings; Nipissing; Manitoulin Is.; Muskoka; Peterborough; Thunder Bay.

Scapania paludicola Loeske & K. M. E. Gate, Algonquin Park.

*Scapania scandica (Arn. & Buch) MacVicar. Small lot determined questionably by Schuster. Beaver Creek, Highway 11, Morrison Twp., Muskoka.

Scapania subalpina (Nees) Dum. Parry Sound; Thunder Bay; Katrine L., Sudbury; wet humus, edge of pond, Lake of Two Rivers, Algonquin Park.

*Scapania umbrosa (Schrad). Dum. Algoma; L. Superior shore, Heron Bay, Thunder Bay.

Solenostoma crenulatum (Smith) Mitt. [= *Plectocolea crenulata* (Smith) Evans]. On damp sandy soil. Fairly common in Algoma; Algonquin Park; Nipissing; High Park, York.

*Solenostoma crenuliforme (Aust.) Steph. Parry Sound.

*Solenostoma hyalinum (Lyell) Mitt. Pottageville and High Park, York.

Sphenolobus hellerianus (Nees) Steph. [= *Isopaches hellerianus* (Nees) Buch]. Algoma; Algonquin Park; Durham; Haliburton; Halton; Manitoulin Is.; Muskoka; Peterborough.

Sphenolobus minutus (Crantz) Steph. Algoma; Algonquin Park; Muskoka; Cape Henrietta Maria, Kenora; Thunder Bay.

*Sphenolobus saxicola (Schrad.) Steph. Moose Factory, James Bay, *Greville*, 1843, in herb. Taylor (NY), according to Schuster (*in litt.*); Ouimet Canyon, 10 mi. N. of Dorion, Thunder Bay, *C. E. Garton*.

Tritomaria exsecta (Schmid.) Schiffn. Algonquin Park; Muskoka; L. Timagami.

Tritomaria exsectiformis (Breidl.) Schiffn. Durham; Halton; Hastings; Manitoulin Is.; Peterborough; Nipissing; Thunder Bay.

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SOME MEXICAN LICHENS

W. L. Dix[1]

The lichens listed here were collected in the summer of 1947 by Dr. Ruth Patrick, Curator of Limnology at the Academy of Natural Sciences of Philadelphia, under a grant from the American Philosophical Society. I am indebted to Mason E. Hale of the U. S. National Museum, Carroll W. Dodge of Washington University, and A. W. Herre for help with determinations.

Anaptychia galactophylla (Tuck.) Trev. Nuevo León, Hualahuises, C. N. 1, 6 mi. N., roadside woods, elev. 1500 ft., 940 in part, 943. Tamaulipas, El Tomaseno, 5 mi. N., on trees in woods, elev. 1400 ft., 900. Det. Dodge.

Cladonia balfouri Cromb. Hidalgo, Chapalhuacán, C. N. 1., on rock, steep cliff, elev. 2700 ft., 109; near Jacala, C. N. 1, Rancho Viejo, steep rocky cliff, elev. 4500 ft., 109a.

Cora pavonia Fr. Nevado de Toluca, volcano, no macroscopic life except caddice larvae, on shores of lake 100 yards from edge of water, elev. 13,500 ft., 288.

Parmelia conspersa (Ehrh.) Ach. Collection data same as with preceding specimen, 282, 287, 290. Det. Hale.

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Parmelia hypotropa Nyl. Nuevo León, Hualahuises, 6 mi. N., C. N. 1, roadside, woods, with moss and hepatics, elev. 1500 ft., 940. Det. Hale.

Parmelia nicolai B. de Lesd. Tamaulipas, El Tomaseno, ca. 5 mi. N., on trees in woods, elev. 1400 ft., 901. Det. Hale.

Parmelia stenophylla (Ach.) Heug. Collection data same as for *P. conspersa*, 319, 320 in part. Det. Hale.

Ramalina complanata (Sw.) Ach. Tamaulipas, El Tomaseno, 5 mi. N., on trees, elev. 1400 ft., 901. Det. Dodge. Var. *complanata* Vain. Nuevo León, Hualahuises, C. N. 1, 6 mi. N., elev. 1500 ft., 940. Det Dodge.

Ramalina laevigata Fr. Same collection data as for preceding variety, with mosses and liverworts, 941. Det. Dodge.

Teloschistes flavicans (Sw.) Norm. Tamaulipas, El Tomaseno, ca. 6 mi. N., elev. 1500 ft., 942; ca. 5 mi. N., elev. 1400 ft., 903, 904, 905.

Usnea angulata Ach. Nuevo León, Hualahuises, C. N. 1, 6 mi. N., elev. 1500 ft., 939.

Usnea comosa (Ach.) Röhl. Nevado de Toluca, volcano, no plants growing in lake, lichens at old hacienda on side of Nevado, elev. 12,000 ft., 277. According to Dr. Herre, "It does not fit into any of the varieties described by Motyka, but comes nearest to var. *sordidula*."

Usnea florida Wigg. Tamaulipas, El Tomaseno, 5 mi. N., on trees in woods, elev. 1400 ft., 902.

Usnea subelegans (Vain.) Mot. Nuevo León, Hualahuises, 6 mi. N., C. N. 1, roadside, woods, with mosses and liverworts, elev. 1500 ft., 938. Det. Dodge.

PERISTOME TEETH IN POLARIZED LIGHT

EDWARD C. TAYLOR, SR.[1]

Steinbrinck (1896, 1897) and Amann (1886) both used polarized light in the study of moss peristome teeth. Unfortunately the former does not give many details about his procedure, the few he does give indicating a fundamental limitation of his method which will be referred to later; and the latter deals only with generalities. Other than in the papers of these two authors moss literature seems to make no mention of this technique. Since their time, however, much has been done in the study of cell walls, and knowledge of the structure of cellulose has been brought to much greater definiteness, as is well summarized in Preston (1952). Polarized light is used by Preston as a major tool, and it seems time to re-investigate its utility as applied to peristome teeth.

Most of the published work on peristome teeth has been done on the microscopic level. It should be emphasized that polarized light is employed to bring out submicroscopic structure. One cannot see under the microscope cellulose chains having crystalline

[1] Hillside Road, Woodstock, Vt.

portions along their length, but their presence and direction can be inferred with great definiteness by their response in polarized light (Preston, pp. 50-69), the effect of which appears only when they are looked at in a direction perpendicular to their length. When viewed in the direction of their length they are isotropic, remaining dark in all positions. A study of a peristome tooth in polarized light, however, requires separation of its ventral and dorsal laminae (not to be confused with separation of the inner and outer peristomes) and frequently also preparation of longitudinal or transverse sections of the whole tooth. When this is done and the laminae and sections are studied in polarized light, it is surprising how many distinctly different types of tooth are found.

It may be well to pass first to the manner in which these observations are made, beginning with the method of separation of the ventral and dorsal laminae. I would appreciate hearing from anyone having another method, for it may well be better than the one to be described. In the first place it should be understood that this method isolates one lamina by sacrificing the other, but that by placing some teeth ventral side up and some dorsal side up, specimens of both laminae can be obtained.

As a preparatory step the teeth (either singly or in groups of 3 or 4) are soaked in a 5% solution of pectinase (a suggestion of Dr. Hannah T. Croasdale, following Wolff & Luippold, 1956). For peristome lamina separation it seems best to soak for 24 hours, and then wash in two or more changes of distilled water. The teeth are then transferred to a thin, small spot of gum syrup on a slide. This is a mixture of two solutions: A—gum arabic 40 g., phenol crystals 0.5 g., water 60 cc. B—cane sugar 52 parts, water 30 parts, both by volume. Take 25 cc. of A, 15 cc. of B, glycerin 2 g. This adhesive can be dried and remoistened at will on the slide, but for attaching the teeth should be almost dry. If the teeth curl they can be moistened with a fine water-color brush (no. 00000), thoroughly damp but not wet, when they generally can be straightened out and stuck down on the gum syrup with either the brush or a needle. Experience with what a particular type of tooth is going to do is more necessary than any cut-and-dried directions. In any case it is desirable to press the teeth against the gum syrup tightly and as flat as possible; this can be done with a piece of a slide lightly coated with some substance which will prevent the adhesive sticking to it. The writer has been using the mold release compound sold by Ward's Natural Science Establishment because it happened to be on his work table, but would expect a light coating of paraffin wax to be as good. One word of

caution, however. The gum syrup should be nearly hard before this pressure is applied, but just soft enough to flow under pressure. If too wet it will form all kinds of unsightly ripples and allow the teeth to move or even pull apart. After pressing, the gum syrup is allowed to harden, the glycerin preventing it from getting brittle.

It has been found better to remove the lamina uppermost on the slide by gentle scraping rather than by cutting, since the cells have been made readily separable from each other by the pectinase treatment. A discarded side-cutting dental tool is excellent. The upper lamina is gradually scraped away, leaving the lower one stuck to the slide. After the loose particles have been removed with a dry brush, the gum syrup is lightly moistened to give a smooth surface and finally allowed to dry. The slide is finished in the usual way in any desired medium, Watson's gum-chloral (1955, p. 14) proving very satisfactory, and by applying a cover glass. A resinous medium can also be used if the gum syrup has been completely dried in a desiccator, but I cannot as yet vouch for its permanence.

The determination of the direction of the cellulose chains in cell walls with a polarizing microscope has been discussed at length by Preston (pp. 50-66) and will be stated only briefly here. A tooth mounted on a slide with one of its two laminae removed is placed on the rotating stage of a polarizing microscope and, with the analyzer inserted, turned to an extinction position. The gypsum plate (Red I) is then inserted in the microscope tube and the stage rotated clockwise. If the tooth lamina turns blue or green upon the red field the chains run N-S when the tooth is put back into this extinction position. If the tooth lamina turns yellow on clockwise rotation a position at right angles is sought and the test repeated. Care must be taken that rotation is clockwise and not the reverse, a mistake surprisingly easy to make. But there is a catch here. It is possible that all the chains are parallel, but it is also possible that those adjacent to one wall are at an angle to those adjacent to the other. What we are really measuring in this case is the major extinction position (the m.e.p. of Preston), which is the bisectrix of the acute angle between the two sets of chains. It is sometimes impossible to distinguish between these conditions by optical means alone, but sometimes it can be done by cutting the lamina between and parallel to its parallel faces, a delicate but perfectly practicable operation with a razor blade. A special case of this, in which the chains are at right angles, will be discussed below in connection with *Mnium cuspidatum*.

Before we go further, let us examine the possibilities when the lamina is isotropic, showing no brilliance in polarized light in any position of rotation. It should be mentioned, however, that the cell walls at right angles to the flat surfaces of the lamina may remain birefringent since in them the chains are usually viewed sideways (Preston, p. 65). The color of these radially extending walls may be imparted in a slight degree to the isotropic flat cells, giving the latter a spurious color which must be allowed for. It may be enough to note that the cells are isotropic, since an isotropic lamina obviously cannot be of the same structure as a strongly birefringent one. But if possible it is desirable to go further. The dorsal lamina in *Dicranum* and in *Mnium* are both isotropic, but the structures are so different that one hates to leave it there. For example, the ventral lamina in *Mnium* has transverse structure, that in *Dicranum* longitudinal structure. The reasons for the isotropic behavior in these two mosses prove to be utterly different.

A dorsal lamina of *Mnium cuspidatum*, with its outer wall against the slide, was carefully pared away with a razor blade until only the part of the secondary thickening adjacent to the outer wall was left (an operation the progress of which could not be followed without checking repeatedly in polarized light). The region adjacent to the outer wall proved to be birefringent with the cellulose chains running longitudinally of the tooth. Since the lamina as a whole is isotropic, the birefringence near the outer wall must be counterbalanced by transverse chains near the inner wall. To prove this an entire dorsal lamina, separated from the ventral one as described, was inverted after moistening the gum syrup, the latter allowed to re-harden, and the lamina pared away until the portion adjacent to the inner wall was exposed. As expected, the chain in the area thus exposed showed transverse orientation In the whole lamina the optical properties of the two sets of chains canceled each other and the over-all effect was darkness (Preston, p. 109).

Having this explanation of the isotropy of the dorsal lamina of *Mnium cuspidatum*, the same treatment was given the equally isotropic dorsal lamina of *Dicranum scoparium*. But no amount of paring produced the slightest change. Obviously we have here a different structure. Now several things can cause a lamina to be isotropic throughout. It may be low in cellulose content, or the chains low in the amount of the crystalline fraction. Random orientation of the chains, or a radial arrangement of parallel chains at right angles to the flat walls of the lamina could do this, the latter, of course, only when the lamina is seen in face view with the

chains thus looked at end on. An arrangement of the chains at right angles to each other but in alternating layers instead of in two groups adjacent to opposite walls as in *Mnium cuspidatum* could also cause the tooth to be isotropic. From some longitudinal sections made of *Dicranum* teeth there would appear to be radial chain structure to a certain extent; other sections show no trace of this and the entire picture is not clear. Rather interestingly, although Preston (p. 97) states that striations are generally an indication of the directions of the chains, this is not the case with the longitudinal striations on the dorsal lamina of the *Dicranum* tooth, possibly because these striations are mainly rows of relatively coarse papillae.

The teeth of typical Hypnaceae (sensu Grout's *Moss Flora*) have both the ventral and dorsal laminae with transverse structure, utterly different from the two types considered above. Both laminae are very strongly birefringent, suggesting that the chains in both are very nearly transverse, possibly in a slow spiral and with the m.e.p. sometimes varying a few degrees from the striations. In most species the transverse structure of the ventral lamina changes to longitudinal near the tip, the cellulose chains being curved between the trabeculae. In some species, as *Brotherella recurvans*, the dorsal lamina also becomes longitudinal in structure near the tip.

One of the species illustrated by Steinbrinck (1897) is *Amblystegium serpens*, which is typically hypnoid. In his fig. 3, however, he shows the dorsal lamina as having a radial structure. This puzzled me considerably until I realized that Steinbrinck relied wholly upon longitudinal tooth sections. Indeed, he states (p. 135) that sections can be dispensed with only when the number of teeth is so great that they are narrow enough to lie on their sides and be examined in profile. Now the only views in which cellulose chains will appear birefringent are those at an angle to their length. Examined axially they are isotropic. A moment's thought will show that a longitudinal section or a profile view of a tooth will show in side view cellulose chains running longitudinally or radially, but that transverse chains appear only in end view, where they are isotropic and therefore invisible in polarized light. Thus by his reliance on longitudinal sections to the exclusion of face views of individual laminae Steinbrinck was cut off from seeing transverse structure and was misled, presumably because at the time he wrote the structure of cellulose had not been worked out as it has been in the last quarter century. This does not mean that longitudinal sections are not useful—they show

beautifully longitudinal and radial structure as well as the relationship between the two laminae—but they should be supplemented by face views of individual laminae.

Another interesting type of tooth is illustrated by *Anacamptodon splachnoides* and *Ulota crispa*, in both of which the teeth move as on a hinge from a position above the capsule to one lying against its outer wall. In both the major part of the laminae is isotropic or practically so, but there is a narrow region at the base of the tooth where transverse structure is very marked. It is obviously this portion of the tooth which causes the swinging movement. Much more work needs to be done in these and other species to correlate wall structure with the hygroscopic properties, which undoubtedly depend for the movement they produce, as Steinbrinck stated, on the dissimilar structure of the two laminae at different points along the tooth.

It would also seem that cellulose chain direction, which is determined by the nature of the cytoplasm of the cell (Preston, p. 100), is a genetic character of the plant and may have taxonomic importance. One striking example is found in *Drepanocladus*. Philibert (1884) pointed out that *Drepanocladus fluitans*, *D. exannulatus* and certain other species lack the characteristic transverse striations of the *Hypnum* group, but are papillose instead, and questions whether these do not form a distinct section in this group. I have had an opportunity to examine only the two named. These two *Drepanocladus* species were from the herbarium of Ethel P. Hutchinson; *D. fluitans* collected in Holden, Massachusetts, and determined by Elizabeth M. Dunham, and *D. exannulatus* collected in McKinley Park, Alaska, by Elizabeth M. Sherrard, and determined by Dr. H. S. Conard.

It is true that the dorsal lamina of *D. fluitans* has fine papillae instead of striations, but under polarized light it has the typical transverse cellulose chain structure of the group, and the papillae are in definite transverse rows. *D. exannulatus*, however, has the fine papillae in random arrangement, and the dorsal lamina is isotropic (except for the radial walls of the cells as mentioned above). Whether this difference in tooth structure has any bearing on the divergent opinions as to whether *D. exannulatus* is a true species or a subspecies of *D. fluitans* I will have to leave to the taxonomists.

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DISCELIUM NUDUM IN EASTERN NEW YORK

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Discelium nudum (Dicks.) Brid. was first found in New York on the State Game Farm at Delmar, Albany Co., by Mr. Charles A. Taylor, June 18, 1946, on clay soil under shrubbery. About a dozen fruiting plants were found. This material is in the Wiegand Herbarium at Cornell University. On April 17, 1952, Mr. Stanley J. Smith found it growing profusely at Gleneire above Kingston, Ulster Co. At this location *Discelium* was growing under the overhanging bank of Esopus Creek on freshly exposed clay soil. Material collected here and at locations found later is in the N. Y. State Museum. On March 16, 1957 Mr. Smith and the writer found *Discelium* growing on a clay slide on the east side of the Hudson River a short distance above North Troy on the "river road," in Rensselaer Co. This road is very unstable and is open or closed depending on how much of it has slid into the river or how much clay has slid onto it. There were a number of slides in this area, but *Discelium* was found on only one of them.

On March 26, 1958, Mr. Smith, Mr. Donald Lewis, and the writer went to the east side of the Hudson River above Stillwater. *Discelium* was found in Washington Co. on a clay slide just south of a small stream called Kidney Creek. Two weeks later the writer found it on a clay slide where N. Y. State road 146 had been widened several years ago just before it crosses the Normanskill between U. S. route 20 and Altamont, Albany Co. On September 20, 1958, Mr. Smith and the writer visited this station by chance and found *Discelium* in an immature stage. The protonema was a conspicuous bright green, brighter than that of *Pogonatum brevi-*

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caule (Brid.) P-B., which was nearby, and more conspicuous than in the spring. The pale yellow-green setae were about one-half inch long, with a distinct green spot just below the reddish-brown tip. The leaves were transparent in comparison with those of the *Pognatum*, which were opaque. Also most of this material had only one row of leaves around the base of the seta, while that collected in the spring had more than one. Apparently fertilization takes place in early September or late August, and the capsules grow in the fall and winter. The spores do not mature until March, as the material collected in early March still had the calyptrae and opercula on the capsules, and spores had been shed in material collected in April.

Some of the material collected in April was permitted to dry without pressing. The setae of this material are so strongly twisted that where several grew close together they twist around each other to form a rope-like mass. One group of five was found intertwined this way, and groups of two and three were common.

The stations on the Hudson faced west, the state road one, northwest. All were in full sunshine for part of the afternoon. On these three, *Barbula unguiculata* Hedw. and *Dicranella varia* (Hedw.) Schimp. were common. All previously mentioned stations were below 300 ft. in elevation. Several clay slides were examined in the spring of 1958 in Schoharie County. *Barbula* and *Dicranella* were plentiful, but *Discelium* was not found. Further search will be made this spring. Clay slides are common in the vicinity of the Gilboa Dam.

PTERIGONEURUM OVATUM IN ONTARIO

HARRY WILLIAMS[1]

Collections of *Pterigoneurum ovatum* (Hedw.) Dix. in North America to date have come only from the West, as far east as North Dakota according to Wareham (1939). It is now known from one locality in southern Ontario, in the eastern Great Lakes region, and thus may be looked for elsewhere in the East. (There is also the possibility that *P. subsessile* will turn up in our region: it has been collected in Illinois, according to Wareham, *l.c.*) The locality for *P. ovatum* is near Millbrook, Durham Co., where the author first collected it in December 1957 and where it was observed during 1958.

[1] Millbrook, Ontario.

Pterigoneurum ovatum requires a well-drained calcareous or otherwise basic soil, dry in summer, with full exposure. Thus in southern England it is at its best on earth-capped walls in calcareous districts. In North America, Koch (1955) has described a desert habitat for the plant in southern California. At Millbrook it was seen on light calcareous loam in a dry hayfield and in small quantity on exposed calcareous till in the middle of an old road two miles from the first site. It grew only in the driest part of the field concerned and was not seen in adjacent stubble fields where its associates *Barbula convoluta*, *Phascum cuspidatum*, and *P. floerkeanum* were of general occurrence.

My observations on *P. ovatum* in the Millbrook area so far cover small numbers of colonies originating in 1956, 1957, and 1958, respectively, mainly in the hayfield, which was seeded down in 1956 and which has not been disturbed since. The plants appear in profusion on fresh soil surfaces in late summer, are at their best in their second autumn when they are seen in small tufts, and begin to disappear in their third autumn as algae and lichens accumulate in a crust on the surface of the soil. Capsules were seen in abundance on all colonies locally, with most spores being matured in early spring, as soon as the soil became warm enough for growth. However there is a succession of plants in any one colony, and while the first capsules might mature in late October, the same colony would show some plants with sporophytes in various stages of immaturity in mid-May when the drying of the soil stopped further development for the summer. In connection with the decline of the species locally, it might be noted that neighbouring colonies of *Phascum cuspidatum* were continuing to flourish in their third year, and that in a suitable habitat *P. ovatum* is capable of greater endurance. Thus Jones (1953) has recorded its persistence on two walls near Oxford for at least eleven years.

The North American range of *Pterigoneurum ovatum* is still incompletely known, but it probably takes in most of the United States west of the Mississippi, with extensions northward into western Canada[2] and southward into Mexico and with local occurrences easterly into the Great Lakes basin. In addition to the data of Wareham (*l. c.*) and Koch (*l. c.*) there is a recent report for the species in Nevada, in which it is cited as a plant of the *Artemisia* or northern desert zone of the state (Lawton, 1958). The record for Saskatchewan given in Podpěra (1954) is presumably based on Drummond's *Musci Americani* (*Rocky Mountains*) 17 & 18, but "Mountain prairies and plains of the Saskatchewan" could refer to part of either present-day Saskatchewan or Alberta.

[2] A specimen from southwestern Yukon collected by H. Crum and W. B. Schofield in 1957 has been seen.

In view of the paucity of records of *P. ovatum* in North America, it seems desirable to place on record the following collections, which I have seen, in the herbarium of the National Museum of Canada.

CANADA. ALBERTA or SASKATCHEWAN: "Mountain prairies and plains of the Saskatchewan," Drummond's *Musci Americani* 17 & 18. BRITISH COLUMBIA: Lytton, *Macoun*, April 16, 1889; Iron Mask Hill, Kamloops, *MacFadden* 4269. ONTARIO: Millbrook, Durham Co., *Williams* 1297, 1447. UNITED STATES. ARIZONA: N. end of Tucson Mts., Pima Co., *Haring* 11468. CALIFORNIA: Antelope Valley, Kern Co., *MacFadden* 18578; Bakersfield, Kern Co., *Koch* 4029. IDAHO: Kootenai Co., *Leiberg* April 1889; Blackfoot, Bingham Co., *Bailey*, Mar. 30, 1904; 12 mi. from Boise on the road to Idaho City, Ada Co., *MacFadden* 18636. WASHINGTON: Pullman, Whitman Co., *Piper* Mar. 24, 1894; Columbia R. gorge near Wallula, Walla Walla Co., *Foster* Feb. 3, 1906 (Holzinger's *Musci Acr. Bor. Amer.* 231); Pullman, Whitman Co., *Pickett* 851 (Grout's *N. Am. Musci Perf.* 338).

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RECENT LITERATURE ON LICHENS—30[1]

WILLIAM L. CULBERSON[2]

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[1] The names of new taxa from the Americas are marked with an asterisk (*).

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———. Lichenologische Notizen (§ 143). On the chemical ingredients of *Usnea diffracta* Vain. *Ibid.* 33(8): 225-226. 1958.

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Arg.) n. c., *S. periculosa* (Duf.) n. c., *S. nivalis* Frey & Poelt n. sp., *S. lertigera* (Weber) n. c., *S. lamarckii* (DC.) n. c., *S. gypsacea* (Sm.) n. c., *S. stella-petraea* n. sp., *S. olcosa* (Zahlbr.) n. c., *S. kansuensis* (Magn.) n. c., *S. crassa* (Huds.) n. c. with v. *crassa* f. *pseudocrassa* (Mattick) n. c. and f. *iberica* (Mattick) n. c. and v. *platyloba* (Mattick) n. c.]

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REICHERT, I. & MARGALITH GALUN. Some lichens on olive trees in Israel. Bull. Res. Council of Israel, Sect. D, Bot. 6(4): 237-244. 12 fig. 1958. [19 taxa. New: *Lecanora olcae* n. sp., *L. hageni* v. *inspersa* n. v., *Caloplaca esdraelonensis* n. sp., *Rinodina magnussoniana* n. sp., *R. carmeli* n. sp., *Physcia leptalea* v. *granulosa* n. v.]

REIJNDERS, W. J. De mosseninventorisatie en -kartering van het Grote Pinetum van Schovenhorst te Putten (G[uelders]). Buxbaumia 12(3-4): 53-57. 1958. [7 *Usneae;* bryophytes.]

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TRASS, H. Eesti NSV lihhenofloora haruldaste ja huvitavate liikide levik I. [Distribution of the rare and interesting species of Estonian S.S.R. lichenflora I.] Loodusuurijate Seltsi Aastaraamat (Loodusurrijate Selts Eesti NSV Teaduste Akad. Juures) [Tallinn] 50: 191-202. 4 fig. 1957. [*Cetraria nivalis* (L.) Ach., *Parmelia acetabulum* (Neck.) Duby, *Peltigera horizontalis* (Huds.) Baumg., *Gyrophora polyrrhiza* (L.) Körb.]

———. Antibiootilistest ainetest samblikes ja Eesti lihhenofloora uurimise ulesannetest. [Über antibiotische Wirkstoffe der Flechten und über Aufgaben der lichenofloristischen Forschung in der estnischen SSR.] Tartu

Riikliku Ülikooli Toimetised, No. 64 (Bot.-Alased Tööd I): 186-197. 1958. [Brief review of the literature. Russian and Germany summaries.]

———. Eesti NSV kladooniate (põdrasamblike) määraja. [Bestimmungstabellen der Cladonien estnischer SSR.] Loodusuurijate Selts Eesti NSV Teaduste Akad. Juures, Abiks Loodusevaatlejale Nr. 39. 116 pp. 6 pl. 3 tab. 1958. [58 spp. Keys. Russian and German summaries.]

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———. Perekonna *Parmelia* liikide uusi leiukohti Eestis. [The discovery of some species of the genus *Parmelia* in Estonia.] *Ibid.* 1(1): 28-31. 1958. [*P. caperata* (L.) Ach., *P. centrifuga* (L.) Ach., *P. conspurcata* (Schaer.) Vain., *P. fuliginosa* (Fr.) Nyl., *P. incurva* (Pers.) Fr., *P. isidiotyla* Nyl., *P. prolixa* (Ach.) Röhl., *P. sorediata* (Ach.) Th. Fr., *P. stenophylla* (Ach.) Heug.]

———. Neli uut samblikuliiki Eesti NSV-s. [Four new species of lichens in the Estonian S.S.R.] *Ibid.* 1(1): 32. 1958. [*Anaptychia speciosa* (Wulf.) Mass., *Cladonia symphycarpia* Flk., *Stereocaulon evolutum* Graewe, *S. glareosum* (Sav.) Magn.]

———. *Cladonia acuminata* (Ach.) Norrl. ja *Cl. foliata* (Arn.) Vain. Eesti NSV-s. [*C. a.* and *C. f.* in the Estonian S.S.R.] *Ibid.* 1(2): 70-75. 2 fig. 1958.

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———. Lišejníky Československých Karpat I. [Flechten der tschechoslowakischen Karpaten (I).] Biológia [Bratislava] 13(12): 890-905. 1 fig. 1958. [30 taxa. New: *Parmelia sulcata* f. *isidiata* n. f. German and Russian summaries.]

WERNER, R.-G. Réflexions au sujet de la zonation au Maroc. Bull. Soc. Sci. Nat. et Phys. du Maroc 36: 319-333. 1956. [Several marine lichens.]

———. Contributions à la flore cryptogamique du Maroc. Fascicule XXI. Bull. Soc. Hist. Nat. de l'Afrique du Nord 48: 441-453. 1957. [55 spp. New: *Dermatocarpon* (CATOPYRENIUM) *macrosporum* n. sp., *Diploschistes scruposus* v. *inactivus* n. v., *Heppia antiatlantica* n. sp., *Lecanora* (ASPICILIA) *maurusiaca* n. sp., *Caloplaca antiatlantica* n. sp.]

[YANAGITA, M.] [Structure of usnic acid.] Jour. Pharm. Soc. Japan 71(1): 53-54. 1951. [In Japanese.]

NEWS AND NOTES

A recent publication, "A revision of the Bryaceae in Japan and the adjacent regions," by Harumi Ochi is available from the author (Biological Institute, Tottori University, Tachikawa-cho, Tottori, Japan), for $1.65. Consisting of 124 pp., it includes an enumeration of species, with keys, descriptions of little-known species, and a number of maps and illustrations.

Dr. OSCAR KÜHNEMANN of the University of Buenos Aires is spending several months at the New York Botanical Garden, studying mosses of southernmost Argentina on a Guggenheim fellowship.

Dr. ISTVÁN GYÖRFFY died after a lingering illness, on April 16, at the age of 78, in Czakvar, Hungary. Active in bryology for many years,

Dr. Györffy was best known for his investigations on teratology in mosses and his work on the bryoflora of the High Tatra.

Dr. Miroslav Servít, well-known Czech lichenologist, died after illness on April 6, 1959. He was 72 years old and an emeritus member of the Agricultural Faculties of Hořice and Kukleny. From 1910 to 1956 Dr. Servít wrote many lichenological papers and several books. After about 1939 he specialized in the taxonomy of the pyrenocarpous lichens among which he greatly revised the classification and described many new species.

Dr. H. H. Allan, student of New Zealand lichens, recently died at Wellington.

Paul L. Redfearn has received a grant from the National Science Foundation for a 2-year study of the bryophytes of southwestern Missouri. He also received a grant for similar purpose from Sigma Xi.

Madame Vera Georgyevna Pachnouva, lichenologist at the Botanical Institute of the Academy of Sciences of the Georgian S.S.R. at Tbilisi, died suddenly in September, 1958. For years Madame Pachnouva had studied the lichen flora of the lands between the Black and Caspian Seas. Her work will not be continued by her successor, Tzimi Inashvili.

Mrs. Winton Johnson of Hackensack, N. J., recently donated the Alfred Tennyson Beals Herbarium to The New York Botanical Garden. The herbarium includes 8776 identified and 4500 unidentified specimens, chiefly mosses but also some liverworts and lichens.

The first volume (of five) of *Index Muscorum*, to be available August 1, has been advertised at $8.00 to members of IAPT, $15.00 to others. Orders should be directed to The International Bureau for Plant Taxonomy and Nomenclature, Lange Nieuwstraat 106, Utrecht, The Netherlands.

Rudolf M. Schuster has an NSF grant for a monographic study of the Ptilidiinae. He expects to make a collecting trip to New Zealand and southern South America in connection with his study.

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Available from the Division of Forestry, Indiana Dept. of Conservation, Indianapolis 9.

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THE HEPATIC EXCHANGE

Beginning January 1, 1939, this Exchange has been operated under the same rules as The Moss Exchange. Privileges are available only to members of the American Bryological Society who have paid annual dues of 25c to DR. LEO F. KOCH, Herbarium, 350 Natural Science Bldg., University of Illinois, Urbana, Ill. Only fully determined specimens in packets with complete data will be accepted. It is suggested that there be at least five packets of each species with an extra which will be forwarded to the Curator of Hepatics for the American Bryological Society Hepatic Herbarium. All material for determination should be sent to the Curator of Hepatics, DR. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

THE MOSS EXCHANGE

As announced in THE BRYOLOGIST **38**: 100, Sept.-Oct., 1935, there is now an exchange for mosses. This exchange is available to members of the American Bryological Society upon payment of annual dues of 25c to DR. E. H. KETCHLEDGE, Dept of Forest Botany, State College of Forestry, Syracuse 10, New York. Only fully identified specimens in packets with complete data on them should be sent in. It is suggested that there be five or more packets of each species.

These two exchanges offer an excellent opportunity for A.B.S. members to build up their own herbaria of choice, well-labelled specimens.